TECHNOLOGY REVIEW

April 1955

TECHNOLOGY DEPT.

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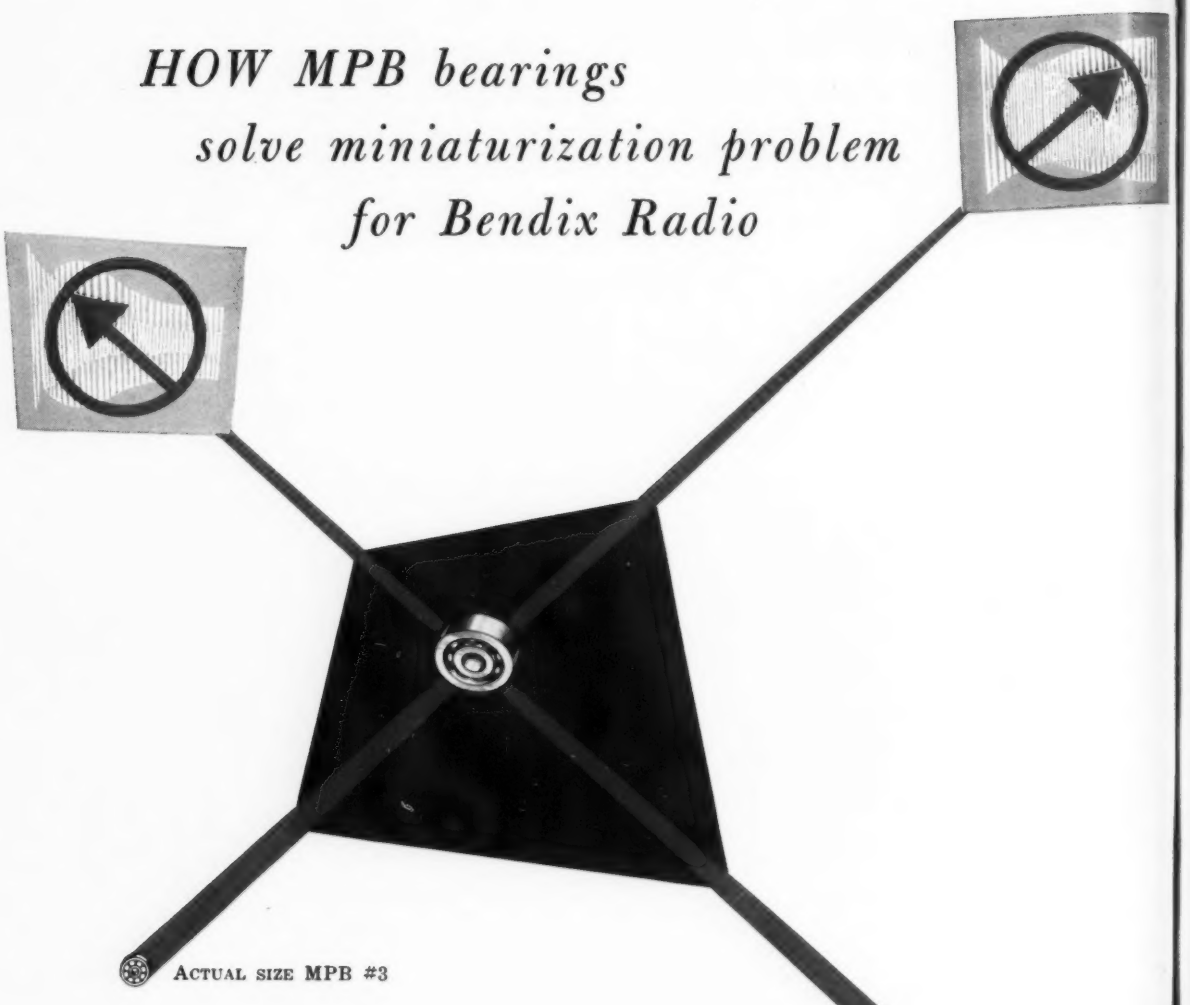
HOW MPB bearings solve miniaturization problem for Bendix Radio



ACTUAL SIZE MPB #3

MPB ball bearing used as Index Pawl in miniature frequency selector switch

OPERATING CONDITIONS — miniature ball bearing serves as index pawl in 4-position indexing device . . . bearing travels at 936 r.p.m. CRITICAL — low starting torque, low friction rotation . . . high impact loads . . . long, trouble-free bearing life. RESOLVED — by use of MPB No. 3, .1875" o.d. full-race bearing.

To quote Mr. John F. Wroten, Jr., mechanical engineer with Bendix Radio Division, these are some of the reasons why MPB bearings were selected in the miniaturization of their frequency selector switch: "The low friction rotation of the bearing practically eliminates drag in the indexing action, and reduces to a minimum the amount of power required for disengagement. Also, the bearing displays unusually high resistance to the frequent impact loads a detent stop of this kind must withstand . . . . Because rolling contact occurs between the pawl and the plate, the plate can be made of soft stainless steel."

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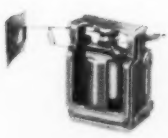
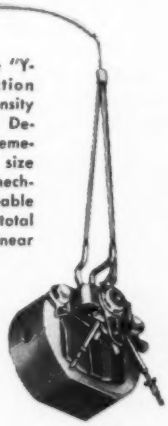
Model 9934—Miniature, self-shielded core magnet mechanism designed for operation of warning flags where space requirements are critical. Capable of 90° total deflection.



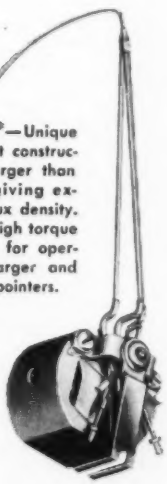
Model 9889—Small self-shielded core magnet mechanism featuring spring-backed jewels for ruggedness and the requirements of vibration and shock; suppressed characteristics if desired; optional location of mounting. Capable of 90° total deflection and can be used for both warning flags and indicator.

Model 9897—Long scale, 250° self-shielded movement, linear motion for operation of pointers where great deflection is a requirement. Capable of sensitivities in the order of 1½ microamperes per degree deflection.

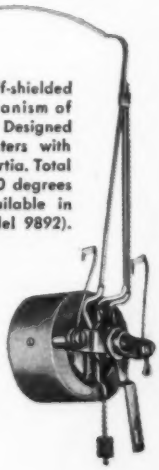
Model 9891*—Unique "Y-Cor" magnet construction giving very high flux density with very high torque. Designed for operating extremely long pointers. Small size makes it ideal for multi-mechanism instrument use. Capable of 45° (22.5-0-22.5°) total deflection, essentially linear up to 40° (20-0-20°).



Model 9890*—Unique "Y-Cor" magnet construction, slightly larger than Model 9891, giving extremely high flux density. The extremely high torque makes it ideal for operation of the larger and heavier type pointers.



Model 9929—Self-shielded core magnet mechanism of high flux density. Designed for operating pointers with high moments of inertia. Total deflection up to 120 degrees available. Also available in miniature size (Model 9892).



*These Models useful as sensitive, self-shielded galvanometers.

WESTON Instruments

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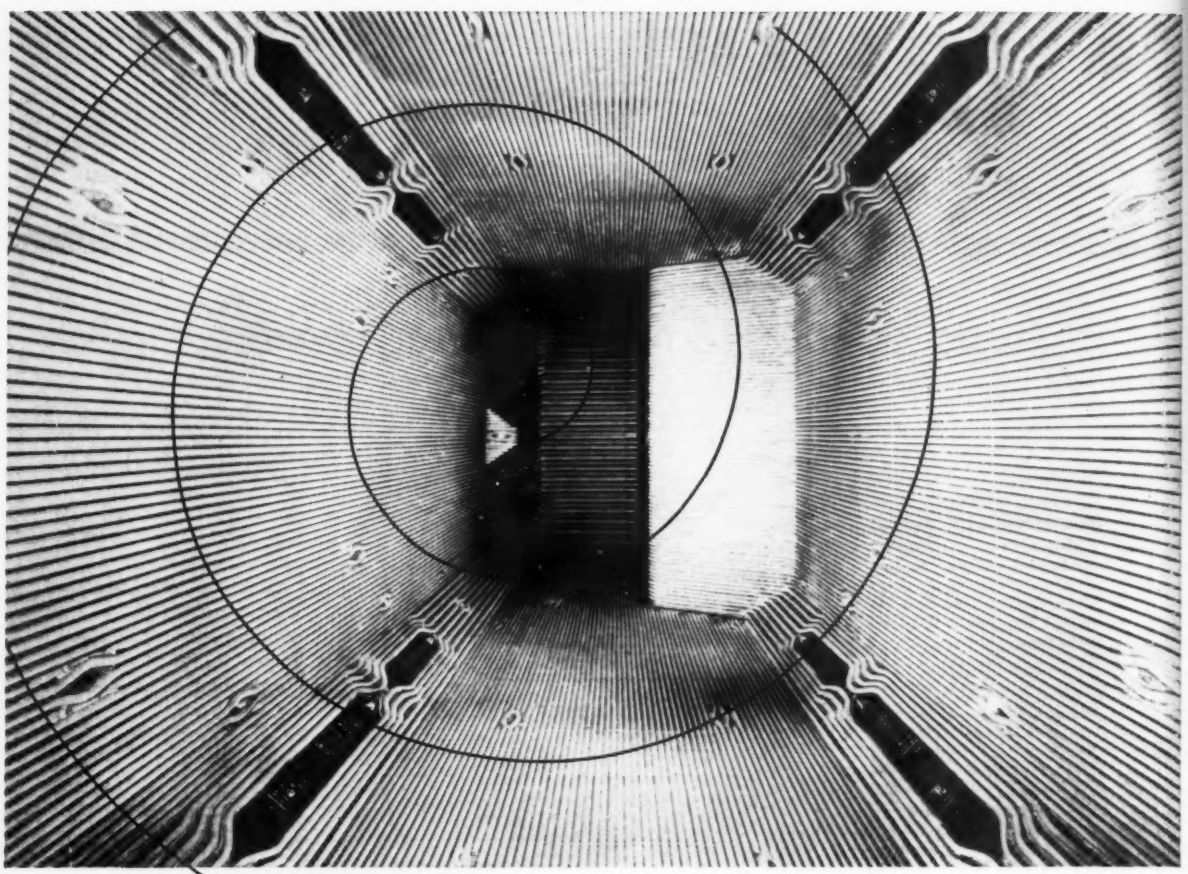

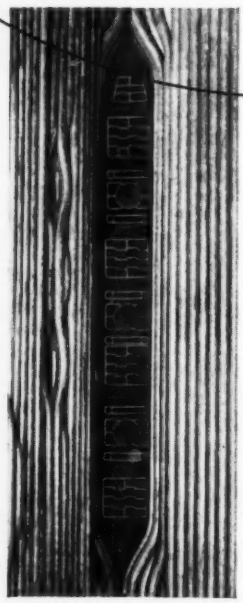

Corner of furnace showing one of four C-E Tilting Burners (Type TV) for firing pulverized coal, oil or gas, separately or in combination.

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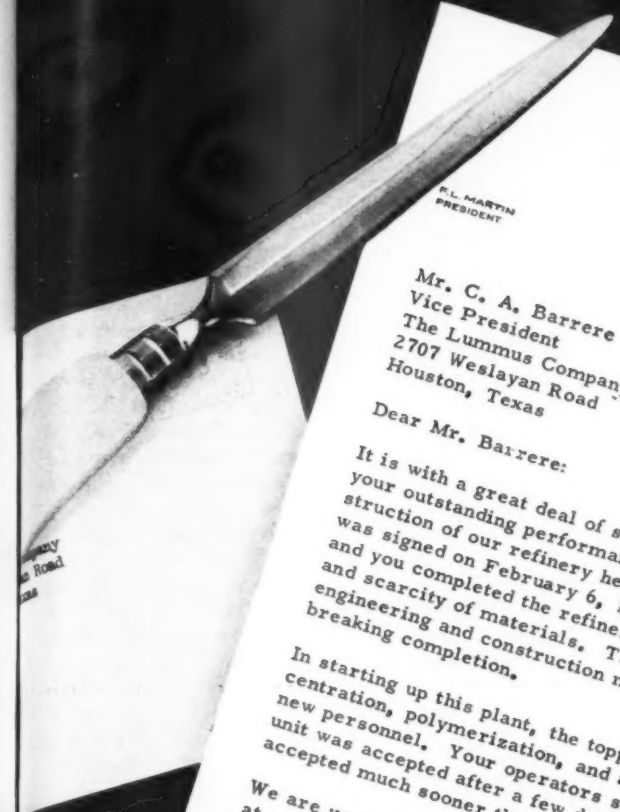

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We are very happy with all phases of the plant. As a matter of fact, it has operated at a greater capacity than originally planned. I am pleased to advise that in all of my refining experience, I have never witnessed a more satisfactory installation, and all of us here at Suntide are very proud of our refinery's performance as well as its appearance.

We would appreciate your extending our sincere compliments for a job well done to all members of your organization who had part in the building of Suntide.

Yours very truly,

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THE TABULAR VIEW

Peaceful Atoms. – Man's knowledge of the atom, and the use to which that knowledge is put, provide problems of the most serious kind for the future of mankind. It is generally recognized that the uncontrolled and improper use of atomic energy can be catastrophic; yet the beneficent use of radioactive particles can also provide important advantages to man's well-being. Many decisions are being made today, with respect to atomic energy, which have a considerable bearing upon, and in turn affect, public policy. We shall have to live by the results of these decisions for a long time. What some of these policy matters are is discussed (page 283) by PROFESSOR WALTER G. WHITMAN, '17, Head of the Department of Chemical Engineering. The Review's article represents the text of an address given at the Southwest Regional Conference in Dallas on January 29, as recorded on page 294. Dr. Whitman received the S.B. and S.M. degrees from M.I.T. in 1917 and 1920, respectively, and Northeastern University awarded him an honorary Sc.D. degree in June, 1954. Except for three periods of service to industry or the nation, Professor Whitman has been closely identified with the Institute's Department of Chemical Engineering (including its Practice Schools) since his graduation from the Institute. In 1926 he joined the staff of the Standard Oil Company (Indiana) as assistant director of research, and in 1930 was made associate director of research. He returned to M.I.T. in 1934 as head of the Department of Chemical Engineering. From 1942 he was on leave of absence to carry on important duties in his professional field. Recently, Secretary General Dag Hammarskjöld, of the United Nations, appointed Professor Whitman to assume responsibility for setting up the first world scientific conference on atomic energy. This conference will be held next August in Geneva. Professor Whitman is also on the General Advisory Committee to the Atomic Energy Commission.

Managerial Thinking. – At the Southwest Regional Conference held in Dallas on January 29, DOUGLAS M. MCGREGOR, Professor of Industrial Management in the Institute's School of Industrial Management, spoke on "The Changing Role of Management." Except for the rather considerable amount of discus-

(*Concluded on page 274*)

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Mo_6Br_{12}

+3

$MoCl_3$

K_3MoCl_6

$MoBr_3$

$MoBr_3.3C_5H_5N$

$Mo_4O_3(C_2O_4)_3$

+4

MoO_2

MoS_2

$MoSe_2$

$K_4Mo(CN)_8$

+5

Mo_2O_5

Mo_2S_5

$MoCl_5$

$MoOCl_3$

+6

MoO_3

MoS_3

MoF_6

MoO_2Cl_2

$MoO(OH)_2Cl_2$

$R^*_x(MoO_4)_y$

$(NH_4)_6Mo_7O_{24}$

$(NH_4)_2MoS_4$

K_2MoS_4

$H_3PMo_{12}O_{40}$

$Na_3PMo_{12}O_{40}$

$H_4SiMo_{12}O_{40}$

$Na_4SiMo_{12}O_{40}$

*R = Ag, Ba, Ca, Ce, Co, K, Li, Na, Ni, Pb, Sr, Zn

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THE TABULAR VIEW

(*Concluded from page 272*)

sion which this talk initiated, Dr. McGregor's address appears in this issue of The Review (page 287). Management's reborn confidence in itself is based on the belief that people are willing to co-operate toward the achievement of a stated objective; it is also based on confidence in the latent abilities of the individual. Such, at any rate, is Dr. McGregor's view, based on two decades of experience in dealing with topics in psychology and labor relations. In 1932 Dr. McGregor received the B.A. degree from Wayne University; from Harvard University he received the M.A. and Ph.D. degrees in 1933 and 1935, respectively. After serving for two years on the teaching staff of Harvard University, Dr. McGregor joined the M.I.T. staff in 1937 as instructor in the Department of Economics and Social Science. He became assistant professor in psychology in 1938, associate professor in 1942, and professor in 1948. From 1948 to 1954 he was president of Antioch College. He returned to M.I.T. last year.

Great Famines. – Since the dawn of human existence, hunger has persistently pursued the predominant masses of mankind. The more serious of the world's great famines are recorded (page 291) by JAMES A. TOBEY, '15, a frequent contributor to The Review. Whether man will ultimately win out, in the race for food, remains to be seen, but Dr. Tobey holds that man now has it within his power to regulate population and food production sufficiently well that starvation in most parts of the world could be a thing of the past. Dr. Tobey received the S.B. and Dr.P.H. degrees from M.I.T. in 1916 and 1927 respectively, the LL.B. degree from Washington Law School in 1922, and the M.S. degree from the American University in 1923. As his latest article goes to press, he is returning to his home in Newtown, Conn., after a pleasant sojourn in West Palm Beach, Fla.

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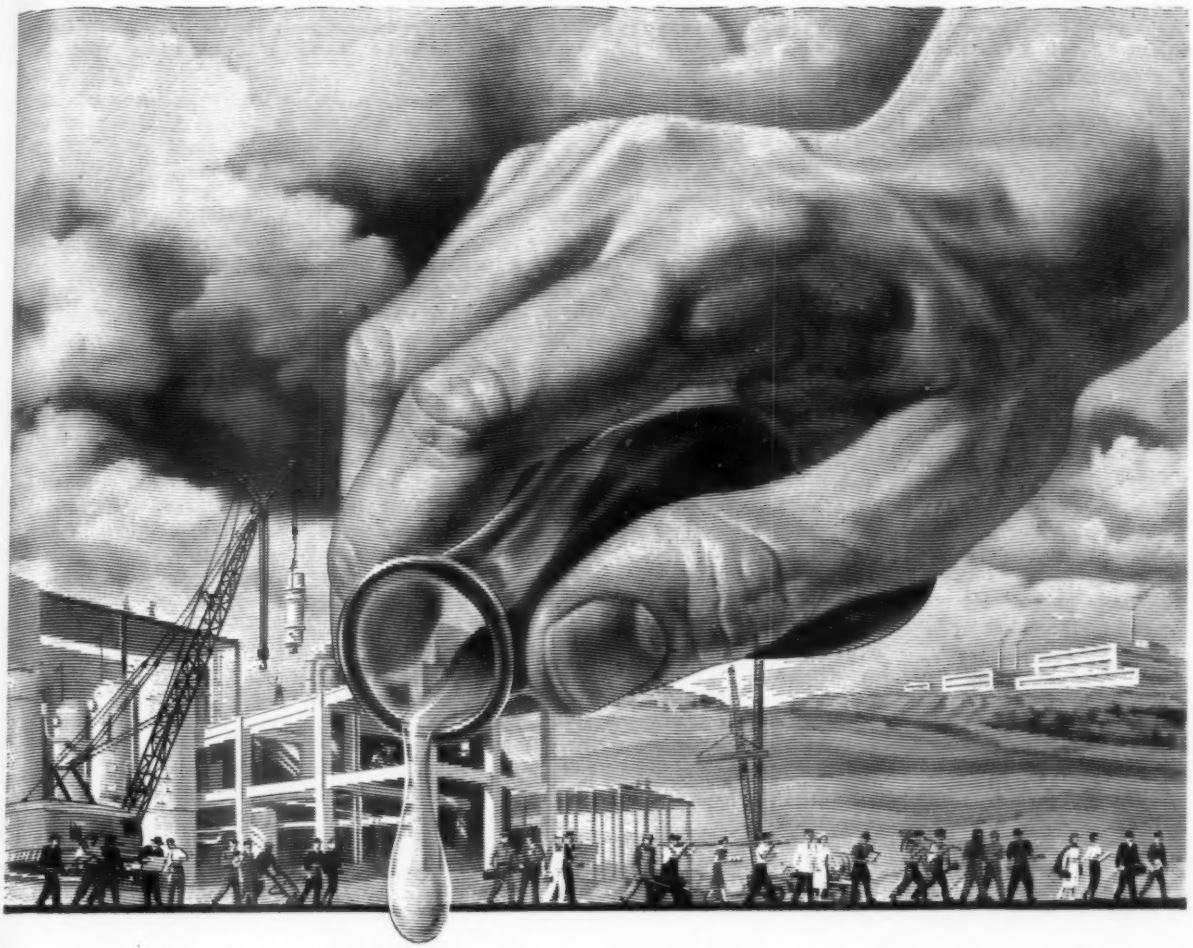

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THE
TECHNOLOGY
REVIEW

Vol. 57, No. 6 April, 1955

The Trend of Affairs

"Staphs" of Life

ALTHOUGH the antibiotics truly merit the epithet "wonder drugs" bestowed upon them by journalists, they have failed to fulfill some of their early promise in the control of infections. This partial failure has been the result of increasing resistance to antibiotics among certain infection-causing microbes. In consequence, some infections that waned in frequency and killing power, during the early years of antibiotics, are now again on the upswing.

Especially prone to develop antibiotic resistance are the staphylococci – "staphs" in medical slang. These spherical bacteria, also known as micrococci, aggregate in grapelike clusters. They are ubiquitous, and are to be found in the noses and throats, on the skins, and elsewhere about the body of virtually all human beings. Many types of staphylococci are harmless; but others can cause infections that are sometimes minor, sometimes serious, even lethal.

As a result of the current intensive use of antibiotics in hospitals, these institutions have become reservoirs of antibiotic resistant staphylococci. Such bacteria are reported to occur not only in patients under treatment, but also in healthy hospital staff members, who no doubt originally get them from patients. Thus, staphylococci of all types were found to be more than twice as common in the respiratory passages of patients just discharged from a communicable disease hospital, as among members of the patients' families who had remained at home. Furthermore, 88 per cent of the staphylococci from the discharged patients were resistant to antibiotics, whereas only 30 per cent of those from patients' families were resistant. Staphylococci from the noses and throats of hospital personnel were 85 per cent antibiotic resistant – the same high proportion as among the patients.

Several instances were observed where a specific antibiotic resistant strain of staphylococci, brought home from a hospital by a discharged patient, had been transferred to another member of the family. Thus, hospital patients may become carriers of antibiotic resistant staphylococci they acquire as a result of treatment in a hospital, or else pick up within the hospital from other patients or from the hospital staff. Resistant microbes may then be transferred to the outside community by discharged patients.

Where did the antibiotic resistant germs originally come from? A recent study suggests that the answer may be simply "survival of the fittest." Methods of classifying staphylococci, based on their reaction to bacteriophage, indicate that the resistant strains apparently existed before the antibiotic era as members of a mixed bacterial population. Since the advent of antibiotics, the susceptible forms have been waning, the resistant forms becoming more dominant.

What is being done about the problem? Sometimes infections resistant to the older antibiotics are controlled by use of newer ones. But this procedure will in time become ineffective, as the discovery of new antibiotics must in time cease. The biochemical basis of antibiotic resistance in microbes is under intensive study, in the hope of finding means of overcoming it. Still another approach is to prevent hospitals from being reservoirs of antibiotic resistant bacteria. This is done by teaching hospital personnel that they dare not be complacent just because the "wonder drugs" are available; that the old-fashioned methods of sanitation, to prevent mechanical spread of microbes, must still be observed as carefully as ever.

◄ *The spirit in this forceful statue of Paul Revere (photographed by Raymond E. Hanson) marched across the nation again when appeals were spread, and met success, to restore the hurricane-damaged steeple of Boston's Old North Church shown in the background. The hurricane which swept New England last fall was no respecter of tradition, but Americans have evidenced their determination to preserve our historic landmarks.*

Local Buckling

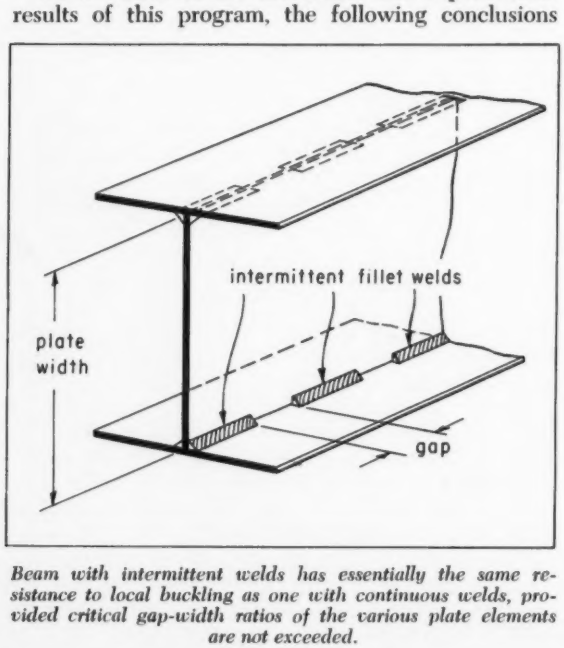
IN the design of typical welded structural members used in bridge building or ship construction, the strength requirements may sometimes be satisfied by using intermittent, rather than continuous, fillet welds. There appears to be no experimental or theoretical evidence to substantiate current design specifications governing the use of intermittent fillet welds, however. The Structural Steel Committee of the Welding Research Council, therefore, sponsored a project to study the local buckling behavior of intermittently welded structural members.

This project was completed recently in the Structural Analysis Laboratory of the Institute's Department of Civil and Sanitary Engineering. Dimitrios A. Polychrone, '47, Louis J. Capozzoli, Jr., '50, and John B. Scalzi, '40, research assistants, conducted this research under the supervision of Charles H. Norris, '31, Professor of Structural Engineering.

When intermittent fillet welds are used, the clear space (or gap) between welds must be short enough to preserve essentially all of the local buckling resistance which the component parts of a member would possess if the welds were continuous. In many cases, the determination of the local buckling characteristics of the component parts of welded struts and flexural members reduces essentially to the study of the buckling of long rectangular plates compressed on the ends and supported on the sides in various manners.

In this project, a theory was developed for the buckling of compressed rectangular plates, which were supported intermittently on the long edges. This theory was compared with the results of an extensive series of tests on both intermittently and continuously supported plates. Based on these plate tests, 12 columns and six beams were designed and tested in the Institute's Structural Analysis Laboratory.

On the basis of the theoretical and experimental results of this program, the following conclusions appear to be justified: (1) If the critical gap-width ratios of the various plate elements are not exceeded, a column with intermittent welds retains essentially all the local buckling resistance of a column with continuous welds. (2) Columns with intermittent welds cannot take the abuse of those with continuous welds, however, and will buckle locally if the average stress is slightly more than the yield point. (3) statements similar to (1) and (2) above, likewise apply to beams, even though in certain cases the intermittent welds are carrying rather large shears.



Beam with intermittent welds has essentially the same resistance to local buckling as one with continuous welds, provided critical gap-width ratios of the various plate elements are not exceeded.

It is recommended that consideration be given to revising current design specifications to include the following ideas: (1) Limiting the permissible gap between intermittent fillet welds to 16 times the plate thickness does not appear to have a very sound and logical basis. From this research, it would seem more rational to limit the gap by using the critical gap-width ratio criterion. (2) Because members with intermittent welds will not take much abuse at stress levels in excess of the yield point, perhaps the use of intermittent welds should be restricted to secondary members.

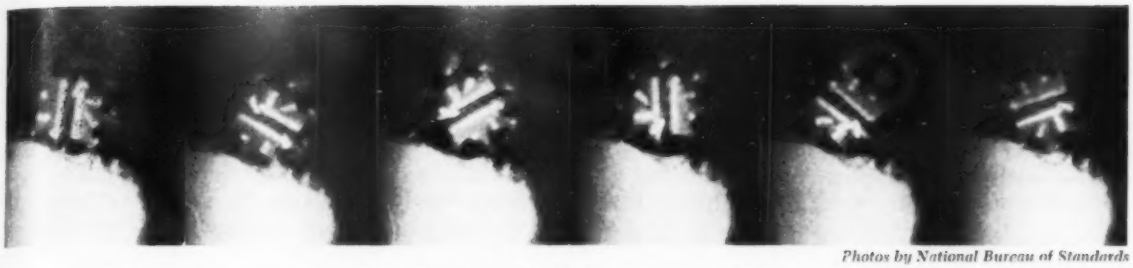
The use of intermittent welds appears to be undesirable both from the viewpoint of local buckling resistance, and of fatigue properties. Thus, it seems that light continuous welds should be used instead, in cases where intermittent full-size welds are being considered.

Open Wider, Please

MUCH of the discomfort of dentistry arises from the vibration and heat generated by "drilling" – the removal of decayed tooth structure. Since all must undergo periodically the ministrations of the dentist, news items about alleged improvements in tooth drilling usually make the front pages. Thus through the years we have read about invention of contrivances of many sorts asserted to make tooth drilling relatively comfortable. But, alas, none of these devices ever seems to reach practical use at the dental chair. Steel or tungsten carbide burs or abrasive stones, rotated in a chuck driven by a flexible shaft, remain the standard methods for drilling teeth.

Some years ago a prominent eastern dentist averred that he was able to obtain (at considerable cost it is true) selected and hand-finished steel burs with which teeth could be drilled comfortably. A rational basis for this assertion has just now come from sequential photographic studies of the cutting action of rotating dental instruments, conducted at the National Bureau of Standards of the U. S. Department of Commerce, with collaboration of personnel from the U. S. Air Force Dental Service. These studies revealed that most dental burs cut inefficiently, and vibrate excessively, because of eccentricity or blade irregularity. If the handmade burs referred to were quite symmetrical and had regular blades, they no doubt did reduce discomfort to the patient.

The National Bureau of Standards photographic studies were done with 16-millimeter high-speed motion picture cameras, operated at from 3,000 to 14,000 frames per second, in order to obtain clear pictures of burs rotating at from 2,500 to 10,000 revolutions per minute, approximating regular low



Photos by National Bureau of Standards

High-speed motion picture frame showing eight-bladed tungsten carbide bur cutting human enamel.

Here another high-speed picture reveals a six-bladed steel bur cutting human dentin.

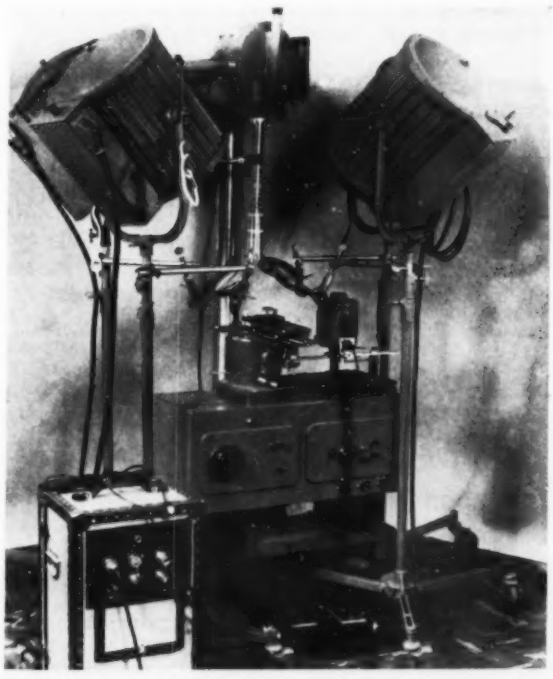
Tungsten-carbide bur cutting human dentin. Larger chips formed by this bur tend to be thrown out of the operating field.

to high dental operating speeds. These films, projected at 24 frames per second, enabled detailed observations of cutting action. High intensity illumination, from eleven 750-watt prefocused flood lamps plus four 1,000-watt spotlights with parabolic reflectors and condensing lenses, was needed because of the short exposure (as little as 1/70,000 second at f/9.2) resulting from the high-speed operation of the cameras.

The films revealed that most of the dental burs observed were inefficient cutters. One type of bur invariably clogged. Pulverized cuttings resulting from inefficient bur action tended to follow a vortex of air created by the revolving bur back into the excavation, thus obscuring the field of operation.

A salient observation was that most of the standard dental burs studied were eccentric, or had irregular blades, or both. These conditions resulted in bouncing, which produced vibration. Bouncing also threw the instrument out of contact with the tooth during part of the revolution, so that not more than half of the blades actually cut. Symmetry and correct blade design, rather than sharpness, determined cutting efficiency. Thus improperly designed tungsten carbide burs cut poorly, even though the blades remained sharp.

The gross observations of cutting efficiency of the rotating dental instruments were quantified, by drilling test substances – such as various tooth tissues –



For slow-motion photography of rotating dental burs, the National Bureau of Standards used this high-speed motion picture camera and auxiliary equipment.

for fixed periods of time with constant speed and pressure, and determining gravimetrically the amount of tissue removed.

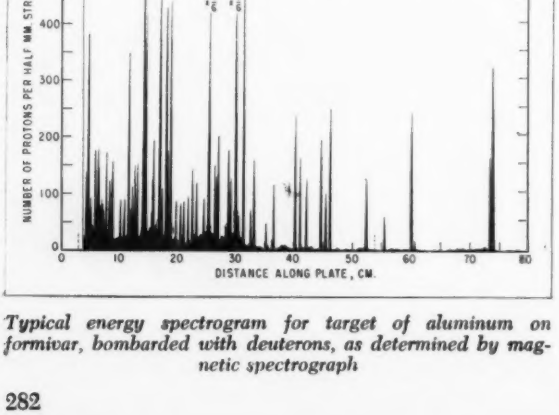
These revelations of the inefficient design of standard rotating dental-cutting instruments lay the basis for improvements. Let us all devoutly hope that such improvements are made forthwith, and find quick adoption by our own dentists.

Magnetic Spectrograph

MUCH of our knowledge regarding the structure of atomic nuclei has come from studies of nuclear reactions. In such studies, one bombards nuclei with a beam of atomic particles (such as protons, deuterons, or alpha-particles) and measures the emitted particles and radiation. The variables which can be controlled are the energy and the direction of the bombarding particle; measurements are made on the numbers and energies of the particles emitted at various angles. Experiments have shown that groups of particles having sharply defined energies are emitted from these reactions, each group corresponding to a particularly stable configuration of the constituents of the nucleus. If the bombarding energy is known, measurements of the energy of the emitted particles enable the calculations of the excited states of the nuclei involved. Such information is analogous to that obtained from the analysis of atomic spectra, the study of which provided the principal clues to understanding the electronic structure of atoms.

In the years since World War II, a research group at the Institute, headed by William W. Buechner, '35, Associate Professor of Physics, and including Cornelius P. Browne, Charles K. Bockelman, and Anthony Sperduto, '42, has played a leading part in the development and the application of the magnetic analyzers to such problems. The magnetic spectrographs developed for this purpose will record simultaneously a large number of particle groups, the arrangement of magnetic field and detector being such that precise measurements can be made on the intensity and energy of each of the groups emitted from the nuclear reactions.

Recently, this group completed and put into operation a new magnetic spectrograph of unique design.



Typical energy spectrogram for target of aluminum on formivar, bombarded with deuterons, as determined by magnetic spectrograph

It is designed to allow rapid adjustment of angles of observation and permits the detection of particles over a comparatively large range of variables so experimental data can be obtained extremely quickly.

By means of a system of slits, a sample of the particles emitted at a particular angle from the nuclear reaction enters the magnetic field of the instrument. The spectrograph disperses the incident particles into a momentum spectrum. A photographic plate, along the line of focus of the instrument, can record the arrival of a single atomic particle.

After exposure and development, examination of these plates reveals the number of particles as a function of their momenta. Thus, information can be readily translated into the energy of the excited states of the nuclei responsible for each of the observed particle groups. For a particular setting of the magnetic field in the spectrograph, the exposed photographic plates record particles with energies varying over a range of 2.4 to 1. Thus, only a few exposures are required to cover the complete energy spectrum of the particles emitted in nuclear reactions. The instrument is so designed as to take full advantage of the new energy range opened up by the accelerator recently built at M.I.T. with support of the Office of Naval Research. The spectrograph is mounted so that it can be rotated about an axis passing through the target in which the reaction under investigation is produced so that observation can be made at any angle between zero and 135 degrees with respect to the beam from the accelerator. Typical of the results obtained with the spectrograph is the curve shown. Data were obtained from a single exposure and show the proton groups emitted when an aluminum target was bombarded with 6-Mev deuterons.

While this apparatus was developed for precision measurements in nuclear physics, its accuracy, resolution, and sensitivity open up interesting possibilities for its use in other fields. From energy measurements on particles elastically scattered from materials placed in the beam from the accelerator, it is possible to determine the composition of the material bombarded. The amount of energy lost by each scattered particle during the inelastic collision depends upon the mass of the nucleus doing the scattering. From measurements on the photographic plates, the mass spectrum of the particles in the target can thus be obtained. Under favorable conditions, exceedingly minute quantities of material can be detected in this way since a layer only one atom thick in the target gives rise to a measurable number of scattered particles. This method for surface analysis actually is used during the course of experiments in nuclear physics to provide a measure of the number of atoms of various masses present in the target used for the experiment. This method of analysis is inherently capable of great accuracy and sensitivity and may find application in industrial processes where exceedingly minute quantities of material must be determined, as in tracer studies.

This development has been carried out in the Laboratory for Nuclear Science at the Institute. This program is supported in part by the joint program of the Atomic Energy Commission and the Office of Naval Research.

Peaceful Uses of Atomic Energy

Dissemination of Technical Information and Help on an International Basis Are Viewed As Means of Making the Atom Man's Servant of Peace

By WALTER G. WHITMAN

I SHALL introduce this talk on the peaceful uses of atomic energy by sketching a framework of public policy within which tremendous activity is developing. My reasons for approaching it this way stem from the experience of the last four years as a member of the General Advisory Committee to the Atomic Energy Commission, including two years in the Pentagon which were concerned almost solely with military problems. Many decisions are being made today which can be best understood if one views them against the background of public policy.

Atomic energy is so relatively new that any valid over-all appraisal of its effects is impracticable today. But one conclusion is certain: atomic energy can be completely catastrophic. It has already revolutionized military problems in strategy and tactics, in equipment, and in forces. It has markedly modified the foreign policy of the United States, and of many other countries on both sides of the Iron Curtain. Potentially the bomb could be developed and possessed by many other nations besides the three that now have it: the United States, Russia, and England. This opens rather frightening prospects if you think ahead. Its ultimate effect on the possibilities of peace are quite incalculable. It may destroy civilization. On the other hand, it may be the imperative challenge which will bring powerful nations to their senses and eliminate major wars.

A little over a year ago, President Eisenhower delivered a message of remarkable statesmanship before the General Assembly of the United Nations. In it he pictured the intolerable situation of two nations armed to obliterate each other and glowering with hostility, but not yet able to find a constructive solution. General [Douglas] MacArthur spoke eloquently in the same vein only late in January. The President outlined an atoms-for-peace program which called for the joint development of the peaceful potentialities of atomic energy as a crusade which would enlist the talent and the enthusiasm of all nations to the benefit of all. He undoubtedly had in mind the tremendous psychological advantage of constructive and co-operative endeavors in a field which has been dominated primarily by suspicion and enmity.

It is against this general policy background that we might consider the plans and the prospects of the atomic energy program. The most highly publicized peacetime use of atomic energy is for the generation of electric power. The technical possibility has been recognized from the start because the controlled fission reaction will release tremendous amounts of energy, and there are many ways in which you might consider utilizing it to make electricity. To date, however, all of these methods which seem practicable involve making steam, which is then used to run turbines.

Some of you know quite a bit about the field of nuclear reactors, but to others the topic may be quite new. You have heard different ways of classifying reactors so I shall merely mention a few of the common classifications and indicate, in oversimplified terms, what they mean.

You have heard about heterogeneous reactors and homogeneous reactors. A heterogeneous reactor has fuel elements – fissionable uranium or plutonium – in solid form, such as rods, tubes, or plates. It is called a heterogeneous reactor to differentiate it from the homogeneous systems. In a homogeneous reactor the fissionable material is in fluid form, such as a solution in water – ordinary light water or in heavy water – or perhaps dissolved in a liquid metal or fused salts. The idea of a homogeneous reactor is naturally attractive to the chemical engineer because it gives him a chance to design a continuous circulating process. However, at the present time, some of the heterogeneous reactors are much further developed toward practical operability.

You have also heard a classification on another basis, dependent upon the energy of the neutrons at the time when they cause fission. This is the distinction between fast reactors and thermal reactors. In fast reactors the neutrons effect fission at the very high energies at which they are liberated; whereas in thermal reactors the neutrons have been slowed down to a fairly low-energy level (thermal energy) before the fission takes place. This slowing down is done by means of moderators. Water is a moderator, heavy water is a better moderator, graphite is a moderator, and beryllium is a moderator. Therefore the reactors are sometimes described as graphite reactors, heavy-water reactors, and the like. These terms refer to the method of slowing down the neutrons to get them into the thermal range. I might add that thermal reactors are the ones that are of the most interest for power production in the near future.

Another classification is between breeders and converters. In a breeder you can start in with a certain amount of naturally fissionable material and end up

H. Armstrong Roberts

with more than you started with, because you have "bred" fissionable material from something which originally was not naturally fissionable. Converters do not go as far as that: they do not make as much new material as they consume. It is therefore very attractive to think about having a breeder reactor which will actually generate additional material and be more than self-sustaining, but as a practical matter this is exceedingly difficult. Looking way ahead, it is entirely probable that we will have large breeder reactors in operation. The big urge to get them, however, will come when the demands for fissionable material for power are so great that one cannot have an adequate supply unless he breeds it in a reactor. For quite a long time to come, the breeder will be something that we are struggling toward, and hoping to get sometime, but do not need vitally at the moment.

There is still another classification based on the method of cooling the reactor. Many reactors are cooled by light water, but heavy water, a gas such as helium or carbon dioxide, liquid sodium, liquid bismuth or a fused salt system are other methods. I have just touched upon these various terms which are used in describing reactors so that you will see what the classifications mean.

Last year the Atomic Energy Commission adopted a policy of support for five reactors which will be built in a program for developing electric power. One of these reactors is a big one, to be built by the Duquesne Light Company and the Westinghouse Electric Corporation, near Pittsburgh. It will be paid for primarily by the government, but the Duquesne people will contribute quite a bit of cash to the development. This could be called a large demonstration reactor to demonstrate that one can produce steadily a significant block of power that can be fed into a regular power system. No one has the slightest illusion that it will be economic. The power is going to cost a great deal more than equivalent power could be made by putting up a steam boiler plant. The other four plants in the program are what we might call pilot plants. They will be much smaller in size but will be prototypes which will be used to develop enough engineering experience to justify going ahead with a big plant, if the estimates show that the process is anywhere near reasonable.

I might give a little description of the cycles in three of these plants to get down to earth for those of you who are not familiar with the plans. The demonstration plant at Duquesne Light Company will be a heterogeneous reactor where fuel elements containing the fissionable material are immersed in a bath of ordinary water. They will be installed in a vessel which will stand very high pressure in which the fission process can go on; the water can moderate the neutrons to bring them down to the proper energy level, and at the same time the water will be circulated to take away the heat. By maintaining very high pressure – which requires a very expensive vessel – one can avoid any boiling of the water in the reactor. This very hot and radioactive water will be pumped around through a heat exchanger, where it will heat a stream of water at lower pressure which will be made into steam and go off to the steam turbines and develop power. Of course, the secondary circuit, where steam is made from ordinary water, will not be radioactive. This is about the system that is used in the *Nautilus*, the atomic-powered submarine.

A second type of reactor to be built – the one that North American Aviation, Inc., is working on with A.E.C. and its own funds – is based upon using sodium rather than water as the cooling fluid and employs graphite as its moderator. This is another heterogeneous reactor with solid fuel elements. The hot sodium which has cooled the reactor is pumped through a heat exchanger, giving up its heat to water

which is thus made into steam for the turbines. Actually I believe that turbines will not be installed because there is no need to prove that steam at such and such a temperature and pressure will make electric power if you put it through turbines.

The third device which I will mention is quite ingeneous if it will work. It is called a boiling water reactor. Until recently it was thought that if the reactor were immersed in water you could not afford to let the water boil, because if any steam were formed the system would go completely out of control. Scientists at the Argonne National Laboratory suspected that this might be wrong and that you could let the water boil right between the reactor elements themselves. The Argonne people tried it out – out in Arco, Idaho – and lo and behold it worked pretty well. This now forms the basis for a scheme whereby the reactor itself becomes the water boiler and makes the steam which goes over to the turbines. There are lots of possible difficulties. In a system like this the water gets tremendously radioactive and the steam will be somewhat radioactive, so the turbines and condensers will get slightly radioactive. It will take actual experiment to find out whether this will be a system which will operate satisfactorily, but if it does, you have eliminated the entire intermediate system of making steam in a separate heat exchanger.

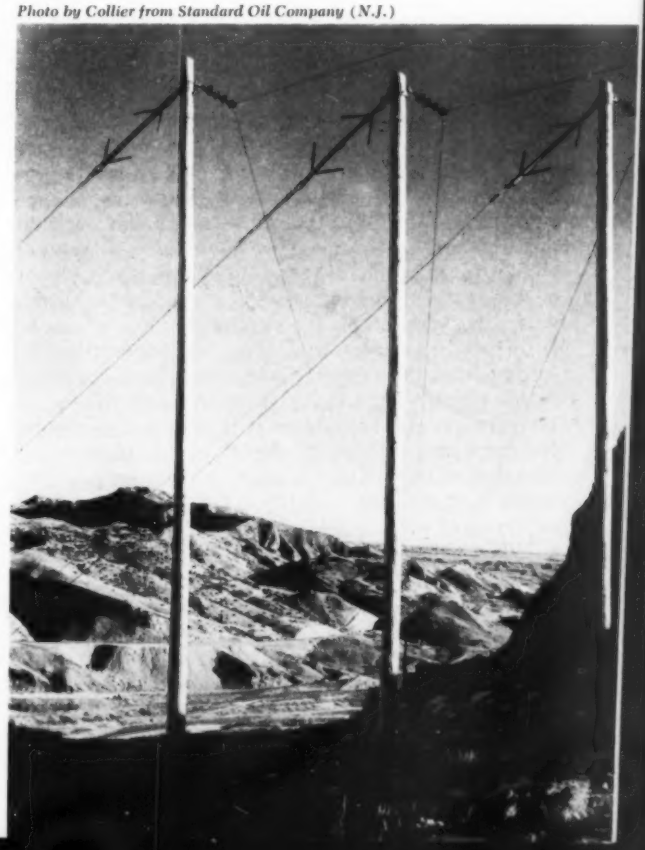
The economic problem in the United States can be expressed in somewhat oversimplified form by saying that if you use atomic energy you are making steam by substituting the energy from fission for the energy from burning coal, oil, or gas. This is on the assumption that we have not yet found some better way of using atomic energy to make electric power than first making steam. Therefore to be competitive in the United States with power from coal, oil, or gas, one must get the investment costs and the total costs of the system down into a reasonably competitive range. Practically that means while you can save on fuel costs, you must learn how to build a plant with an investment that is somewhere close to the investment in a steam boiler. That is a pretty tough challenge. The investment does not have to be as low as that of a steam boiler, but it must be within gunshot, otherwise investment charges just lick you. I am talking now on the basis of current prices of coal, oil, and gas. On these first plants the investment will, of course, be far too high. Thus, the plant that is being built near Pittsburgh may represent an investment of $1,000 per kilowatt of capacity, and you really must get down much lower to make interesting competition.

The technical problems are very difficult, but there are some top-notch brains working on them. I guess if one thought back in the oil industry, a good many of the things which we do today looked to be almost impossible when we first tackled them. While one must recognize some very serious barriers there is no reason to feel that just because we do not know how to surmount certain problems today, there is no reason to think it cannot be done. Experience is accumulating all the time and new materials and methods are being developed. Incidentally, industry as a whole is getting a great deal of new knowledge and capabilities from the experimental work that is going on to develop atomic power reactors.

As you probably know, there have been many studies of atomic power by associated groups of companies – usually utilities, equipment manufacturers, and perhaps a chemical company working together – for the Atomic Energy Commission. All the information that was needed was laid before them and this industry group came up with a report to the A.E.C. giving their views of how atomic power might be produced industrially. Of course, the A.E.C. rather hoped that a little hard cash for construction would be laid down on the line, but all of these studies pretty much convinced the A.E.C. and Congress that it was premature to expect private capital to take much risk at this stage. Congress cooperated by passing a new Atomic Energy Act which makes it much more practicable for private industry to get involved in the private generation of power.

The Atomic Energy Commission is now putting out feelers to see what might be developed. On January 10 they issued two releases, one of which marked a rather important step in establishing a schedule of prices that the A.E.C. would charge if a company wanted to buy or rent materials from the A.E.C. for power purposes, and prices that it would pay for plutonium, used fuel elements, or things like that. The price of heavy water is included in the list. These prices have not been publicly released. The announcement merely says that the A.E.C. has set these prices, which will hold for a seven-year period, and companies who are interested and have the necessary clearance may see them.

Photo by Collier from Standard Oil Company (N.J.)



Raymond E. Hanson

The other announcement concerned the A.E.C.'s desire to get proposals from industrial groups for building plants to make power. The A.E.C. expects to be involved in some subsidy for these big demonstration plants. That is just realism. They are inviting applicants who are willing to assume the risk of construction, ownership, and operation of reactors (designed to demonstrate the practical value of such facilities) to send in their proposals to the A.E.C. and let the Commission see whether any of them are interesting enough to be approved. The methods of support that the A.E.C. can give are something like these: They can rent out fissionable materials – fuel elements and so forth – to the private producer and then waive any rental payment so that he really gets them free except for any losses. Another way of support is for the A.E.C. laboratories to perform certain research and development work for these companies which is pertinent to the development without charge. A third method is to give a research and development contract to the applicant under which he is to supply technical and economic information resulting from the design, construction, and operation of his plant. The A.E.C.'s decision as to whether a given proposal is acceptable will be based on a number of factors, such as whether this particular project promises to contribute interesting information, how much it is going to cost the A.E.C., and how much evidence of private risk-taking there is in it.

When will atomic power come? There are so many factors in it that I do not see how anybody can tell with accuracy. Individual estimates depend a good deal upon optimism or pessimism, but here are some important factors. How well are these pilot plants going to run? Will the experience with them quickly permit designs in which the investment costs can be reduced to reasonable figures, remembering that safety factors have to be carefully considered? Certainly there is a big expansion in the total demand for power ahead and it will be quite possible for atomic energy to come into the country's power system – and still all the other ways of making power may be expanding at the same time. Whether the present strong government support will be continued as a matter of policy is of course very significant. Will there by a sharp change in the government's attitude? Frankly, I do not think so. Experience with military propulsion plants, such as the submarine and the aircraft, and with the small package power unit that the Army wants for the Arctic and other isolated locations, will aid progress toward power plants for electric utilities. What will be the price of coal in the future? I speak of coal rather than of oil or gas because, in the long run, coal is the backbone of this country's electrical power output. It is not really important to the oil industry, or to the gas industry, whether very much of their product goes into the manufacture of electric power.

It is quite evident that atomic power will be attractive in other countries before it is in the United States. Britain, for example, which used to export coal, is now importing coal as well as oil. They are really far more interested in using atomic energy than the United States is because it offers another source of energy and promises to release them from grave restrictions on future power supplies and their expansion. Brazil and many other countries which must import fuel are eager for it. It is anybody's guess as to when atomic energy becomes really significant as a power producer. I would guess that we will have a number of good-sized atomic plants in this country within the next 10 years. Whether any of these plants are going to be economic without subsidy is

(*Continued on page 312*)

The Changing Role of Management

Management's Reborn Confidence in Itself Is Based on Belief in Willing Co-Operation of People, and Confidence in Abilities of the Individual

By DOUGLAS M. McGREGOR

About the time the sit-down strikes occurred in Detroit, I entered the field of human relations in industry. Some of you may remember back to those trying days. During the almost 20 years since then, I think it is fair to say that there has been a major revolution in the thinking, the practices, and the philosophy of American management.

This is not true, of course, of all management. It is most apparent today at the top of organizations, although it is filtering down through lower levels too. Most of us have been so close to the day-by-day problems that it is hard to realize how much change has occurred in the time of which I am speaking. Let us consider, for a little while, some of the changes that have occurred in the period of the last 20 years.

It is easy to list certain developments that have occurred in the management field. Many new programs and practices of management have come along, to be sure. However, I am looking for something more than this. What are the broad changes in point of view that have affected management's role as it has operated in American industry? What are the significant threads that are gradually making a pattern in the fabric of our industrial life? There are several of these, and I propose to talk about three which seem to me to be especially significant.

The first thread I would like to mention is the realization that the successful operation of an industrial organization, in a free enterprise system, requires the *willing* collaboration of the people who comprise the organization. We have not always believed this to be so. In fact, this idea wasn't at all common even 20 years ago. The prevalent notion in management thinking in those days was that if the work was to get done, people had to be made to do it. The basic concept of motivation we relied on was that of fear. Fear of loss of employment and other forms of economic punishment was what management used to keep people at work.

Throughout these last 20 years and more, we have discovered that force in human affairs – as in physics – breeds counterforce. We have discovered the degree of ingenuity that human beings can exercise against management in such forms as restriction of output, all kinds of subtle sabotage, militant unionism, and the like. We have begun to learn that, if we attempt to use force, the counterforces will tend to defeat the purpose we are trying to achieve. Therefore, most of us have come to the realization that it is management's task to create the kind of conditions that lead people to want to do the job, and to collaborate willingly in achieving organizational goals.

In looking back, I think evidence is to be seen of the growth of this conception in management's thinking. Consider, for a moment, the developments in wage and salary administration over the past 20 years. Certainly these have served one important purpose – that of helping to convince people that their wages and salaries are set on a fair basis, and that they need not be concerned about arbitrary action. If people are convinced that their earnings are equitably established, perhaps they will be more willing to collaborate with management.

In most companies the basic climate in which union-management negotiations occur has changed very remarkably in the past two decades. We still read about an occasional difficult conflict situation in the newspapers. But close study and examination (such as the National Planning Association has given in recent years) to bargaining in companies where the relationship has settled down and become "healthy," indicates an entirely different pattern than was formerly characteristic. Today we see the pattern of people working across the table from each other, trying to find the reasonable and fair way to resolve their differences so that all will be willing to work toward a stated goal or objective.

The development of the personnel administration function has helped to create willingness in the organization. For example, consider the importance we place, today, on good communications in an organization. Throughout the entire organization we strive to let people know what is going on, to help them understand the changes that are about to take place, and therefore to be more willing to adjust to the circumstances they have to face.

And finally, consider the general emphasis which today's management places on the whole structure of motivation. We have been shifting around from the negative emphasis on fear, to the search for positive incentives which will lead people to collaborate willingly toward organizational objectives.

To a large extent these changes have resulted from trial and error. One company discovers something useful, or a university conducts some research that leads a management to try out a new method. If the new technique works out well, other companies copy or adopt it. We like to "keep up with the Joneses"

in this field as we do in other respects. Gradually a lot of changes occur. Finally, out of the details of improved practice and the gradual day-by-day shift in our attitude or policy, something emerges that is broader and deeper than any of the contributing factors. We are becoming genuinely conscious of the fact that the willing collaboration of everybody in the organization, from the Board of Directors to the janitor, is essential if we are going to get the output – and the economic results and the human results – we desire.

The second thread involves another matter of attitudes. This is a growing feeling of confidence, on the part of management, in the potentialities of people. We no longer hear management talking about employees as "hands." Labor is no longer seen solely as a commodity. We are beginning to regard people as individuals – whole human beings – who have remarkable potentialities. By and large we have not yet tapped these potentialities in industry, up to now.

"Potentiality" may lead you to think in terms of productivity. However, I am not concerned with productivity in the narrow sense of the word – of how many ergs of energy a man develops, or how many units of effort per hour (or per day) he expends, or whatever else is usually meant by productivity. Productivity is important, of course, but sometimes we tend to overemphasize it. What I am concerned with is the potentiality which we sense when we become aware of what ingenious, creative minds can do when there is encouragement, under the proper circumstances, to help make the enterprise a more successful one.

Ingenuity is a cornerstone of our civilization. It is characteristic of the janitor and the bench hand, as well as of the director of research and the vice-president. Only now are we beginning to recognize these potentialities. I have a feeling that 20 years from now we may look back on our present attempts as clumsy and inept ones, but there are signs that we are groping in the right direction.

One example of present groping is that whole area which is practically a fad today in management thinking: decentralization and the delegation of authority. This topic would not be emphasized if we did not have increased confidence in people. We don't talk so much today about the concept of span of control – that one man can supervise from five to seven other persons – even though this topic is still treated in textbooks. The reason for this is that we have begun to change our conception of supervision, particularly at higher managerial levels. We realize that it isn't necessary to "breathe down the neck" of every man who is reporting to us, to control his actions.

The concept of decentralization means, in effect, that we have enough confidence in men to outline the broad range of their responsibility and authority, and then to turn them loose to find a way to do the job – without supervision in the narrow sense, but with full expectation that their efforts will produce the desired results.

This kind of relaxation of control is possible only because we have come to have a genuine confidence in people and what they can do Firms, such as Sears, Roebuck and Company, and Johnson and Johnson have demonstrated some remarkable achievements along the lines of delegated authority.

In the last two or three years the same concept has been carried still lower in the organization, and today we hear about job enlargement. To be sure, in part, job enlargement has been accelerated by the process of automation that has been discussed at the Regional Conference this afternoon. The people in an automatized organization must exercise a different and higher level of judgment than those in firms where automatization has not yet appeared. People are upgraded for their higher level of judgment, as they have been in the oil industry, which has largely gone through the automation process. Today we recognize that the worker is capable of exercising judgment, and so job enlargement is coming to replace excessive specialization, which has been characteristic of the last few years.

The concept of participation is bandied around a great deal today in industry. It represents, in one more way, a growth in management's confidence in people and their potentialities. When the idea of participation was first introduced, 10 or 15 years ago, it came with the idea that we needed more "democracy" in industry. However, the rather naïve idea that democracy implies that everyone is going to decide everything is not the core of the concept of participation.

There is quite another characteristic of democracy which is relevant to participation. It is this: If people are freed from the restraints of rigid authoritarian control, then – given proper cicumstances and motivation – they will help to create a better society. This is the concept of participation which we are gradually exploring and finding to be very fruitful.

The work of my colleague, Joseph N. Scanlon, lecturer in the Department of Economics and Social Science at M.I.T., has led to the adoption of the participation idea harnessed and utilized in a special manner – the Scanlon Plan – in a number of industries. Most of the companies which have adopted the plan are showing remarkable economic achievements, above anything that would have been predicted.

We have a great deal more to learn about the limits of participation and about its potentialities, but the point I wish to make is simply this: Management would not be experimenting at all with the idea if some fundamental attitudes had not shifted. Management has, today, a new confidence in people and what they are capable of doing.

The field of executive development provides still another illustration of changes in managerial thinking. Instead of seeking personnel for top management posts in a very small stratum of our industrial society, we are recognizing that potentialities, latent in many people, can be developed so that they can become capable of top management responsibility.

A year and a half ago, I had the experience of attending a 13-nation European conference on the subject of executive development. It was interesting to see how our European friends were only just beginning to grasp the importance of this concept which, after 15 or 20 years, is now quite familiar to us. For

H. Armstrong Roberts

generations Europeans have attempted to draw their managers from a very narrow segment of society on the assumption that this segment contained the only people with the necessary capacity. It was only when this small group could no longer supply the growing need that attempts were made to look lower down in the organization for potential leaders.

Finally, in this connection, I refer again to our current emphasis on communications. When, through programs of communicating with employees, we attempt to tell them what we are about, we do so because we have confidence in their good sense. Otherwise we would not bother to tell them.

Not long ago one big company developed a series of films intended to enhance the economic education of its employees. It was designed to show people how their company operated, what its philosophy was, and how it fitted into the general economy. After this set of films was shown to people throughout the organization, I was talking with one of the executives about the problem of evaluating its effect. I was interested to find that the executive was not planning any "before and after" measure of attitude. Instead, he was trying to develop a method that his firm could use to indicate whether, as a result of seeing and discussing the film, people would take more variables into account as they considered the complex problems of our economy. You don't talk as that executive did unless you have a pretty high level of confidence in the common sense and intellectual ability of the average person. He was saying, in effect: "People are bright enough, smart enough, and sensible enough so that they are likely to arrive at wise answers if they only recognize how many variables there are. I don't argue that they ought to arrive at the same answers I do."

This development – this thread of a growing confidence in people and their potentialities – has not been a logical, planned result of management action. It is emerging out of trial-and-error experience in dealing with people. As a result. instead of defining management as the direction and control of the elements of production – machines, money, processes (and, incidentally, people) – we are defining it today as the conservation, the development, and the utilization of the human resources of industry. The emphasis is on people as a resource.

The third and last thread in the picture that I want to talk about today is that of management's self-confidence in itself. The dominant characteristic of top management in our society 40 years ago was probably arrogance. The executives were on top of the heap, and they knew it.

During the thirties, management came under severe attack from many quarters, and became understandably insecure and defensive. But today, it seems to me, management has begun to achieve a genuine self-confidence. Executives display the kind of confidence characteristic of a respected profession, including a concern for ethics, and genuine humility.

Perhaps some of you have seen Adolf Berle's new book on the American capitalist.* It is the second one he has written in which he has pointed to the power that big corporations have in our economy. However, there is an interesting change in his point of view in this book as compared to the one he

* Adolf A. Berle, *20th Century Capitalist Revolution* (New York: Harcourt Brace and Company, 1954).

wrote a few years back. The change is simply that he can see very little evidence that the managements of our big corporations have exercised their power in ways detrimental to society. They have exercised self-restraint. This is a facet of the self-confidence that is making management a real profession today.

There are two or three other symptons of management's emerging self-confidence which deserve mention. First, I would mention management's growing willingness to exercise authority in the real sense of that term, with readiness to accept the consequences.

During the depression and post-depression days, when management was facing the tremendous problems of militant unionism, there was a swing away from an authoritarian concept of authority to what almost amounted to anarchy. In many instances, management simply abdicated. We have come back to a balanced middle position in which management is willing to make decisions, to absorb the uncertainties which go into making them, and to accept the inevitable hostility that goes with the exercise of authority. No important decision pleases all.

Incidentally, the personal pattern of adjustment to authority turns up frequently as significant in the research on leadership behavior. The adjustment pattern involves authority in several directions. First, how does the individual deal with authority above him? Is he too submissive to it or, on the other hand, is he too resentful of it? Can he live with it in a comfortable fashion? Second, how does he handle his own authority? Does he grab it too quickly; does he exercise it like the new "cop" on the beat? Or, on the other hand, does he try to avoid it? Does he try to evade consequences of exercising authority? Or does he accept the more difficult position of living with the responsibility, the anxiety, and the consequences of his actions and decisions?

The second symptom of management's developing self-confidence is the acceptance of the fact that conflict and disagreement in human organizations are inevitable. We have gone through a long period of searching for sweetness and light. We have hoped for that blessed state in which everyone will agree with everybody, everyone will love everybody, and no one will quarrel with anybody about anything. The simple fact is that if we had organizations like that, they would be completely "dead on their feet."

It is only in those organizations where people disagree, where new ideas can come up and be knocked down and be fought about, where people can differ sharply and sincerely about important issues, that we find growth and development and vitality. To seek for peace as a condition of health is basically nonsense.

I have recently talked with a management concerned with the problems created by a rigid policy of promotion from within. This group was raising such questions as these: Are we getting enough new blood into the organization? Are we permitting the capable person – who happens to be a "porcupine" – to grow, to develop, and to climb in the organization? If we create a mold in which we all think alike, in which everyone agrees all the time, are we going to be able to meet the kind of problems that will surely face us a little farther down the road?

One more evidence of management's self-confidence is the fact that the line manager is coming to accept full responsibility for human relations and for personnel administration. For a long time there was a consistent attempt to get rid of this type of responsibility. In fact, part of the impetus to the development of the field of personnel administration was an attempt of line management to slough off the responsibility of dealing with people.

Management was not too busy: it simply wanted to avoid difficult, complex, and sometimes frightening problems. We know now that we can't operate an organization successfully by neglecting problems in human relations. The staff has its function – and

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Photo by Corsini from Standard Oil Company (N. J.)

Great Famines of the Past

Man's Ingenuity and Efficiency May Overcome Starvation, Putting an End to the Frightful Adversities That Blighted Europe and Asia in Times Past

By JAMES A. TOBEY

WAR, Famine, Pestilence, and Death; these are the Four Horsemen of the Apocalypse. With "breastplates of fire and jacinth and brimstone," they have ridden together down through the ages. In the somewhat fantastic prophesies of the Revelation, conquest was mounted on a great white horse, famine on a black horse, and disease on a red horse, while death inevitably followed on a pale horse.

The fearful four horsemen rode jauntily, mockingly, when the first colonists came to the Americas. A year after the conquest of all Mexico by a little band of Spanish adventurers under Cortes, a terrible epidemic of smallpox swept across the land, claiming as its victims millions of the susceptible Indians. This scourge, previously unknown in the New World, was brought in 1520 by a Negro slave in the train of Narváez, who came to compel stout Cortes to renounce his command, but failed in the attempt. A similar experience with pestilence occurred a few years later in Peru, and was to be repeated many times thereafter.

Famine, disease, and hostile Indians were responsible for the failures of the first English endeavors to colonize in North America. In 1585 Sir Walter Raleigh enthusiastically sent 108 settlers to Roanoke Island in what is now North Carolina, but a year later all the survivors of this discouraged group returned to England, only a few days before relief arrived. A second company of 121 persons was dispatched by Raleigh to Roanoke in 1587, but this colony disappeared without a trace.

The Virginia colony, established at Jamestown in 1607, was ravaged by starvation and disease, and barely survived through the valiant efforts of the leader, Captain John Smith. In 17 years 5,649 colonists came to Virginia, but in 1624 only about 1,100 remained. Some had, of course, become discouraged and had returned to the homeland, but many had succumbed to privation and disease, or had been killed by the Indians.

The members of the Plymouth colony, founded in 1620 by the Pilgrims, suffered a similar fate. During that first terrible winter in the bleak New England climate, more than one-half of the 101 original settlers were secretly buried in the hills, victims of malnutrition and other maladies. These Pilgrim Fathers were made of stern stuff, however; despite all disasters the colony endured and eventually prospered. The survival of the English in America was, moreover, undoubtedly aided by the fact that a consistent scarcity of food always had tended to keep down the Indian population.

Since those early days the United States never has known famine in the true sense of the word — an extreme and general scarcity of food causing disaster among large sections of the population. To be sure, there have been numerous instances of undernutrition and even of starvation in local areas, and in 1930 a situation approaching famine occurred in certain farming sections, but this country has been spared the type of famine which has devastated other parts of the world. Some of the great famines of the past have taken their toll in the millions.

In the annals of recorded history there have been at least 500 famines of such magnitude and of such fearful mortality as to impress and startle the chroniclers. In North China, for example, a three-year famine from 1876–1879 is said to have caused 9,000,000 deaths, while a series of famines, from 1860 to 1900, in India, where famine has been called "only the exceptional aggravation of the normal misery," are alleged to have been responsible for 15,000,000 deaths. In England alone, more than 200 notable famines have been experienced since the beginning of the Christian Era, and these are but a small fraction of all that have occurred in Europe over the course of the centuries.

The first widespread famine that we know anything about took place nearly 5,000 years ago during the Third Dynasty in Egypt. The story of it is carved on a stele of granite on the Island of Sahal in the first cataract of the Nile, and is attributed to King Zoser, of Tosorthros, who reigned over Egypt about 2900 B.C. The monarch laments for the vast misfortune visited upon his country, saying that the Nile flood has not come for seven years. "Light is the grain," he says, "there is lack of crops and all kinds of food. Each man has become a thief to his neighbor. . . . Torn open are the chests of provisions, but instead of contents there is air. Everything is exhausted."

About a thousand years later, when Joseph came to Egypt and gained the favor of the Hyksos king by interpreting a dream, famine again stalked the land. As chief administrator for the pharaoh, Joseph prepared for another seven lean years, a dearth which drove his father, Jacob, and his 10 brothers

out of Canaan into the valley of the Nile in search of sustenance. The narrative is told, better than I can tell it, in the Book of Genesis (Chapters 41–46). The Bible mentions 10 noteworthy famines, which were usually attributed to the wrath of God (II Samuel XXI). One of these was the 10-year famine which sent Naomi out of the land of Judah to the country of the Moabites, and evoked the eloquent plea of Ruth, "Entreat me not to leave thee." In another of these Biblical famines, the siege of Samaria by the King of Syria, occurred the first recorded instance of cannibalism. As told in the Second Book of Kings, a woman complained bitterly to the King of Israel that she had bargained with another woman to boil and eat their sons, but that the other woman had hidden her son after partaking of the petitioner's. During the severe famines of the Middle Ages cannibalism often flourished, and was not punished.

The glory that was Greece and the grandeur that was Rome were frequently dimmed by disastrous periods of famine, usually coupled with war and pestilence, with the pale horseman hovering near. Among the worst of these was a series of famines which began in Italy in 460 B.C. and extended over 20 years. Then came the sack of Rome by the Gauls in 390 B.C. The barbarians took the city, but failed to capture the Capitol, which they besieged for seven months. Starvation was about to force the brave garrison to capitulate when for some inexplicable reason the Gauls suddenly folded their tents and disappeared from the scene. Perhaps they, too, were hungry.

Rome at the zenith of its power under Augustus, immediately preceding the Christian Era, seldom was visited by famine. So great was the extent of the Roman domains, so powerful the fleets of ships, and so potent the administrative system, that dearth in one section of the empire was promptly alleviated by the dispatch of grain from other areas. Most famines have been due, in fact, to absence or failure of effective methods for the distribution of food, as well as to such conditions as drought, floods and inundations, prolonged winters or summers, frost, and hail. Other factors which have promoted famines include war, epidemics, insect and rodent pests, deforestation, and failure of a single food crop, such as rice, corn, wheat, or potatoes, upon which an entire nation depends for sustenance. A plague of locusts can ruin a food supply in a matter of hours.

Thus, Nature and Man have been and are both responsible for great famines. During the reign of Trajan, Rome came to the relief of her Egyptian colony when the Nile was low once again, but in the decade from 79 to 88 A.D. drought and famine prevailed and were accompanied by the violent volcanic eruptions and earthquakes which buried Pompeii and Herculaneum at the foot of Mount Vesuvius. In these years the blights of famine and pestilence fell upon Africa and Syria, the granaries of the Roman Empire; with resulting privation throughout the civilized world.

The Norman conquest of England, dating from the day when William the Conqueror defeated Harold at the Battle of Hastings in 1066, was followed by widespread famine and pestilence. It was not the first of such disasters in Britain, for there had been a terrible famine from 1005 to 1016, but in 1069 the scarcity of food was so great that the people consumed dogs, cats, horses, rats, and other animals, and cannibalism was said to have been rife among the hungry and destitute. Suffering continued unabated for many years during the reigns of William Rufus and Henry, and it became even more acute in the time of the crusading Richard Coeur de Lion (1157–1199). Another severe famine occurred in 1235, when 20,000 persons are reported to have succumbed to starvation in London alone.

Then came the terrible Black Death, the pandemic of bubonic plague, in the middle of the Fourteenth Century, which was preceded by, accompanied by, and followed by extensive famines. This tremendous epidemic came out of Asia to Venice in 1347, and swept across Europe like an unquenchable fire, taking a toll that has been variously estimated at one-quarter to one-half of the entire population of that continent. The only human destruction comparable to this in the whole of history was the pandemic of influenza in 1918–1919.

In the closing years of the unusually long reign of Louis XIV in France, from 1643 to 1715, famine and starvation were rife among the poorer subjects of this extravagant monarch who is so often called, or perhaps miscalled, "The Magnificent." It is said that three-fourths of the people lived on a few handfuls of barley and oats, and that death and emigration so reduced the population that every seventh house was empty. One of the king's current favorites, Madame de Maintenon, was accused of profiteering in the sale of grain and was mobbed by a hungry horde when she drove out of the gates of Versailles. A century or so later, famine was one of the factors that led to the frenzy of the French Revolution. Another notorious period of starvation in France occurred during the siege of Paris in the Franco-Prussian War of 1870–1871.

One of the significant famines of recent times was that which took place in Ireland in 1845–1846 as the result of the failure of the potato crop. A blight had struck the potatoes of Ireland in 1822, but the disaster of a quarter of a century later was even worse. About a quarter of a million persons are reported to have died of starvation and disease engendered by it during this period, and another million and a half emigrated to other lands, including the United States. About this same time, in 1848, there was a severe famine in Germany, which also stimulated emigration to the American land of plenty. The "hungry forties" helped to inspire the invidious communist manifesto of Karl Marx (1847).

Frightful as were these many adversities in Europe, they seem puny compared to some of the truly enormous famines in Asia in the past. Ten million persons are said to have died of starvation in India when the monsoons failed in 1769–1770, and there were other periods of famine amounting to catastrophe in 1780 and 1790. China is reported to have experienced about 1,800 famines in the past 2,000 years, of which several hundred have been on a really grand scale. The Russian peasant likewise has

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THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

J. M. Faulkner Becomes Medical Director

JAMES M. FAULKNER, Dean of the Boston University School of Medicine, has been appointed medical director of the Institute, effective next July. In announcing the appointment, James R. Killian, Jr., '26, President, said:

"We are fortunate in obtaining the benefit of the broad background and medical experience of Dr. Faulkner as Medical Director at M.I.T. In his new post he will have administrative responsibility for providing comprehensive medical services for a community of approximately 12,000 students, faculty, and employees."

Dr. Faulkner is a native of Keene, N.H., where he was born on December 16, 1898. He was graduated from Harvard College with the degree of bachelor of arts in 1920 and received his medical degree from the Harvard Medical School four years later. From 1926–1927 he was assistant in medicine at Johns Hopkins Medical School, and from 1928–1940 he was, first, an assistant in medicine, and later, an instructor in medicine at the Harvard Medical School. It was in 1940 that he was appointed assistant professor of medicine in the Boston University School of Medicine, and three years later became professor of medicine in the Tufts College Medical School. In 1947 he returned to the Boston University School of Medicine as Dean and Professor of Clinical Medicine.

M.I.T. Photo

Dr. James M. Faulkner
. . . who becomes Medical Director at M.I.T. on July 1, 1955

Alumni Association Names Corporation Term Members

PHOTOGRAPHED below are the three nominees for alumni term membership on the M.I.T. Corporation – mentioned in the Institute Gazette section item "Democracy in Action" in the March issue of The Review (page 246). Effective with the fiscal year of the Alumni Association which begins on July 1, 1955, the following will serve for five years:

Hugh S. Ferguson, '23, XV, President of Dewey and Almy Chemical Company, Division of W. R. Grace and Company, Cambridge (and this year's president of the Alumni Association); Fred C. Koch, '22, X-B, President, Wood River Oil and Refining Company, Inc., Wichita, Kansas; and Max L. Waterman, '13, II, Vice-president, and Director, Singer Manufacturing Company, New York City. Messrs. Ferguson, Koch, and Waterman have held important posts in industry, and maintained an active interest in the Alumni Association and the Institute.

Kampper, Belmont

Hugh S. Ferguson, '23, XV
President, Dewey and Almy Chemical Company (Grace Division), Cambridge

Math. Borniger

Fred C. Koch, '22, X-B
President, Wood River Oil and Refining Company, Inc., Wichita

Pach Bros., N.Y.

Max L. Waterman, '13, II
Vice-president and Director, Singer Manufacturing Company, New York City

Thompson Photography

Head table guests at the Dallas Conference included (left to right): Bernardo Elosua, '23, H. E. Lobdell, '17, Mrs. Edward O. Vetter, John G. Trump, '33, Mrs. Dayton H. Clewell, Walter G. Whitman, '17, E. L. DeGolyer, Mr. Green, and President Killian.

Eisenhower Appoints Killian

PRESIDENT Eisenhower has appointed James R. Killian, Jr., '26, a member of the Committee for the White House Conference on Education. President Killian will be one of 32 persons selected to conduct a national conference on the nation's educational problems. The White House Conference on Education is part of a national plan to enlist citizen action to improve education.

The Presidential Committee will assist states and territories, when requested, in planning and holding their conferences. It will also conduct a national conference on November 28 to December 1 of this year, and prepare a report to President Eisenhower on significant and pressing educational problems.

Dr. Killian is chairman of the Army Scientific Advisory Panel. He is a member of the Executive Committee of the Association of Land Grant Colleges, the Association of American Universities, the Science Advisory Committee of the Office of Defense Mobilization, and the Board of Visitors of the U.S. Naval Academy.

Thompson Photography

Regional Conferences

FROM reports reaching The Review's editorial office, high enthusiasm was demonstrated by the 700 Alumni and friends of M.I.T. who attended the Southwest Regional Conference in Dallas on January 29, and the 275 additional well-wishers of Technology who took part in the Third M.I.T. Midwest Conference in Cleveland on February 26. For several years the Institute's Administration and Faculty have worked in close co-operation with alumni clubs in different parts of the country in developing conferences, particularly in industrial regions, that would report on the latest progress in science and technology, as developed at M.I.T.

This year the Dallas conference, held in the Hotel Adolphus, was devoted to "Frontiers in Science and Engineering"; the Third Midwest Conference, held in Cleveland's Mid-Day Club, was given to a discussion of "The Beneficent Uses of Science." Of particular significance is the fact that in both cases, approximately half of those who attended were friends of M.I.T. who were invited by Technology Alumni. The high interest which the programs evoked was apparent in the number of questions that were asked after conclusion of each address, and the seriousness of discussion of current technological problems.

The Southwest Regional Conference, sponsored by the M.I.T. alumni clubs of southwestern United States and Mexico, offered a full day's program of intellectual stimulation, from registration at 9:00 A.M. to about 10 P.M. when James R. Killian, Jr., '26, concluded his address. A welcome to those attending was extended by Dayton H. Clewell, '33, President of the M.I.T. Club of Northern Texas. Professor Walter G. Whitman, '17, Head of the Department of Chemical Engineering, opened the conference session with an address "How Peaceful Uses of Atomic Energy May Affect Petroleum." The text of Professor Whitman's remarks appears on page 283 of this issue of The Review. The second of the morning conference papers was delivered by John G. Trump, '33, Professor of Electrical Engineering, who spoke on "Atomic Particles and Radiation – Friends of Medicine and Industry."

After luncheon, Norman B. Robbins, '37, President of the M.I.T. Club of Fort Worth, opened the after-

◄ *Dr. Killian and Cecil H. Green, 23, visibly indicate the enthusiasm and good will evidenced at the Dallas Conference.*

Also present in Dallas, seated at the speakers' table (left to right) were: Edward O. Vetter, '42; Robert E. Wilson, '16, Dayton H. Clewell, '33, Mrs. E. L. DeGolyer, Hugh S. Ferguson, '23, Mrs. Cecil H. Green, C. S. Draper, '26, Mrs. John G. Trump, D. M. McGregor. *Thompson Photography*

noon session with introductory remarks, which were followed by the showing of a motion picture portraying the new industrial revolution which may be anticipated as a result of recent progress in automatic control equipment. The general theme of this motion picture was amplified by Professor C. Stark Draper, '26, Head of the Department of Aeronautical Engineering, who opened the afternoon conference discussions with an address on "Built-in Brains for Man-Made Birds." The second conference paper of the afternoon was "The Changing Role of Management" by Douglas McGregor, Professor of Industrial Management, text of which is on page 287.

Toastmaster for the evening banquet was Edward O. Vetter, '42, conference chairman, who introduced the two speakers of the evening and brought the day's events to a successful conclusion. Robert E. Wilson, '16, chairman of the Board of the Standard Oil Company (Indiana) and a member of the M.I.T. Corporation, spoke on "Maintaining the Pace of Scientific and Technological Development."

President Killian gave the final address of the evening. His talk, entitled "Making the Most of Our Human Resources," emphasized the important role which colleges and universities play in the nation's development. Viewed as opportunites for extraordinary service – for which the institutions of higher learning must make adequate preparations immediately – was the growing number of students who might be expected to double college enrollment by 1970. Although Dr. Killian's remarks were drawn primarily from experience at M.I.T., he discussed the broader problem of higher education on a national scale.

Sponsored by the M.I.T. Association of Cleveland, the Third Midwest Conference on February 26 also provided a full day's fare of thought-provoking discussions on the beneficent uses of science. The morning session was opened by William H. Robinson, Jr., '24, who, as President of the M.I.T. Association of Cleveland, presided at the morning session. Manson Benedict, '32, Professor of Nuclear Energy in the Department of Chemical Engineering, spoke on "Harnessing the Neutron for the Research Laboratory."

John E. Arnold, '40, Associate Professor of Mechanical Engineering, spoke on "Creative Engineering and Product Design." He outlined the growth of creative thinking, both in industry and in educational fields.

The afternoon session was presided over by William C. Sessions, '26, chairman of the Conference Committee. Professor Gordon S. Brown, '31, Head of the Department of Electrical Engineering, presented the first afternoon conference paper entitled "Automation – It Touches All of Us."

The second, and final, speaker at the afternoon session was John G. Trump, '33, Professor of Electrical Engineering. In speaking on "The Beneficent Particles – Electrons," Dr. Trump reviewed and illustrated some of the exciting medical and industrial advances which are being developed.

Paul W. Litchfield, '96, chairman of the Board of the Goodyear Tire and Rubber Company, a distinguished Alumnus of the Institute, and President of the Alumni Association in 1929–1930, was honored at the banquet in a presentation made by Mr. Robinson, toastmaster. On behalf of the Alumni Association, Mr. Litchfield was presented with a set of commemorative bone china plates, and a certificate of appreciation from the Alumni Association.

Following Mr. Litchfield's response to the presentation, Richard S. Morse, '33, President of the National Research Corporation, spoke on "This Business of Research."

President Killian had been scheduled to make the address, "Bringing the Institute to You," as the concluding event of the banquet, but was prevented from leaving Cambridge because of illness in his family. John E. Burchard, '23, Dean of the School of Humanities and Social Studies, attended the Midwest Conference in Dr. Killian's stead, and delivered the message which M.I.T.'s Head had prepared especially for this occasion. President Killian's message called for an increase in the quality of higher education in the United States. A key point in any program aimed to accomplish this end is the need to strengthen science education in the secondary schools, for the universities can but build on the human material coming from the high schools. The problem is made difficult, in President Killian's view, by the need to double the size of the nation's educational system in the next 15 years or so.

That the two 1955 Regional Conferences were stimulating was never questioned by any who attended either the Dallas or the Cleveland gathering. Plans are now under way to hold three Regional Conferences in different parts of the United States in 1956.

Class Reunions

The following classes are planning to hold reunions this year, and the listing given below includes the information available to date on the locations and dates for these gatherings:

1890 June 13. In conjunction with Alumni Day; possibly a Class Meeting after Alumni Day Luncheon. George A. Packard, Secretary, 25 Avon Street, Wakefield.

1891 June 11. Annual meeting and reunion. The Country Club, Brookline. Harry H. Young, President, 290 Main Street, Cambridge 42.

1900 June 9-12. The Pines, Cotuit, Mass. Percy R. Ziegler, reunion chairman, 984 Memorial Drive, Cambridge 38.

1905 June 10-12. *50th reunion.* Belmont Hotel, West Harwich, Mass. Fred W. Goldthwait, Secretary, 274 Franklin Street, Boston 10.

1907 June 10-12. Oyster Harbors Club, Osterville, Mass. Bryant Nichols, Secretary, 23 Leland Road, Whitinsville.

1910 June 10-12. Chatham Bars Inn, Chatham, Mass. John B. Babcock, 3d, reunion chairman, Room 1-263, M.I.T., Cambridge 39.

1915 June 10-12. New Coonamessett Ranch, North Falmouth, Mass. Azel W. Mack, reunion chairman, 40 St. Paul Street, Brookline 46.

1916 June 14-15. Chatham Bars Inn, Chatham, Mass. Cocktail party, Hotel Statler, June 13, 4:45-7:00 P.M. Ralph A. Fletcher, Secretary, Box 71, West Chelmsford.

1920 June 11-12. Sheldon House, Pine Orchard, Conn. Edward S. Farrow, reunion chairman, 343 State Street, Rochester, N. Y.

1921 June 13. Hotel Statler, Boston. Class meeting at 5:00 P.M. Carole A. Clarke, Secretary, 215 Linden Avenue, Glen Ridge, N. J.

1922 June 12. Sunday afternoon, Frank Wing's Home, 53 Chiltern Road, Weston, Mass. Prebanquet get-together at Hotel Statler, June 13. C. Yardley Chittick, Secretary, 41 Tremont Street, Boston 8.

1925–June 10-12. June 10–Reunion Headquarters, Hotel Continental, 29 Garden Street, Cambridge. June 11– symposium and lunch with Class of 1930; banquet in evening at Faculty Club. June 12–outing to Castle Hill, Ipswich, Mass. F. Leroy Foster, reunion chairman, Room 5-105, M.I.T., Cambridge.

1930 June 10-13. *25th reunion.* Baker House, M.I.T., Cambridge 39. Morell Marean, reunion chairman, 21 Rocky Ledge Road, Swampscott. George P. Wadsworth, deputy chairman, Room 2-285, M.I.T.

1935 June 11-12. Chatham Bars Inn, Chatham, Mass. Ernest E. Van Ham, reunion chairman, 391 Broadway, Somerville.

1940 June 11-12. Snow Inn, Harwichport, Mass. Robert A. Bittenbender, reunion chairman, 287 Waban Avenue, Waban 68.

1945 June 10-12. Hotel Curtis, Lenox, Mass. Reunion chairmen: Thomas A. Hewson, 3 Millbrook Road, Medfield; David A. Trageser, Concord Road, Wayland.

1950 June 11-12. Treadway Inn, Coonamessett, North Falmouth, Mass. Donald R. Miller, reunion chairman, Stop and Shop, 393 D Street, South Boston 27.

1955 Alumni Day

A CONFERENCE to be held in the morning on Alumni Day, June 13, similar to that which was held last year (entitled "The Next 10 Years") is being planned by Avery H. Stanton, '25, chairman of the 1955 Alumni Day Committee, and Donald W. Kitchin, '19, deputy chairman.

The theme of the conference will be "Uses and Economics of the Peaceful Atom." Edward L. Cochrane, '20, M.I.T.'s Vice-president for Industrial and Governmental Relations, will serve as moderator for the panel group which will participate in the morning program on Alumni Day.

The panel will include John von Neumann who has recently been appointed a commissioner of the Atomic Energy Commission. Speaking on the topic of the peaceful atom, Dr. von Neumann will discuss its "impact on the physical and chemical sciences." Another panel participant will be Dr. Shields Warren, Professor of Pathology at the New England Deaconess Hospital. Dr. Warren, who was formerly director of the Division of Biology and Medicine, Atomic Energy Commission, will discuss the atom's "impact on the life sciences." Completing the panel group, Keith Glennan, President of the Case Institute of Technology, will present his views on the atom's "impact on our economy and way of life."

A Look Ahead

THE 130 members and guests who attended the 308th meeting of the Alumni Council on Monday, February 28, were treated to an unusual survey of current events taking place at the Institute. As President of the Alumni Association, Hugh S. Ferguson, '23, opened the Council meeting after dinner at the Faculty Club. Principal speakers of the evening were Professor Jerome B. Wiesner, Director of the Research Laboratory of Electronics, and James R. Killian, Jr., '26, M.I.T. President, who has recently completed an important assignment in Washington.

The major items on the business portion of the meeting have already been enumerated in the March issue of The Review or are treated editorially elsewhere in this section in this issue, and accordingly will be omitted as a part of this report.

As chairman of the Alumni Fund Board for the current year, Theodore T. Miller, '22, reported that 8,220 Alumni had contributed $302,000 to the 1955 Fund as of February 28. These figures represent 25 per cent of Technology's active Alumni.

In appreciation of his successful term as President of the Alumni Association for the year 1953–1954, Mr. Ferguson then presented a gavel to Horatio L. Bond, '23.

(*Continued on page 298*)

BUSINESS IN MOTION

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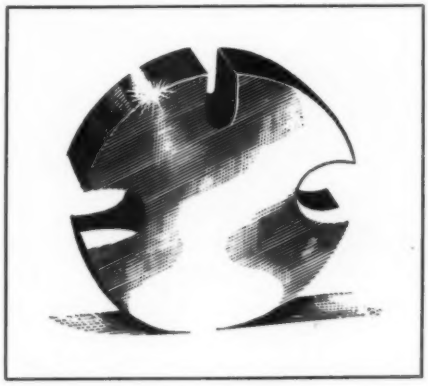
It is almost always the fact that an extruded shape costs more per pound than metal in a standard form, and that it offers economies only because it materially reduces machining. Now Revere reports an unusual case in which an extruded shape actually costs 25 cents less per pound, so that it saves money in first cost as well as in finishing. Thus this shape, which is a large one, weighing 62 pounds per foot, offers compound economies.



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THE INSTITUTE GAZETTE

(*Continued from page 296*)

As Director of the Research Laboratory of Electronics, Dr. Wiesner stated that his laboratory had been established to provide a continuing research program on peacetime problems in the broad field of electronics, when the Radiation Laboratory was disbanded, upon completion of its wartime program. He discussed the basic philosophy underlying the operation and administration of the laboratory, and outlined its accomplishments in the past five years.

For a full hour President Killian informed Council members of recent developments at the Institute. The Institute faces important policies with regard to enrollment, especially in view of the increasing number of young persons who will attend college in the future. The Institute can probably accept a slightly increased number of students in a few Departments without adding significantly to its physical facilities, but there is a limit to such expansion. The high quality of M.I.T. education is attested by the fact that 10 per cent of all those receiving fellowships from the National Science Foundation elect to study at the Institute. A study made by Wesleyan University shows that M.I.T. is among the top five institutions in the number of graduates it sends into graduate work. Already 10 per cent of the undergraduate student body at Technology comes from foreign countries, and this condition is bound to

(*Continued on page 300*)

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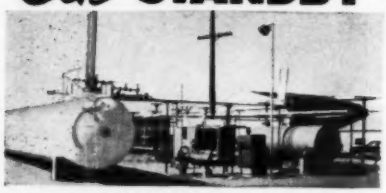

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THE INSTITUTE GAZETTE

(Continued from page 298)

affect the composition of the Alumni Association in years to come. Likewise, the number of women students continues to increase. At present there are 125 studying at the Institute, and this growing number presents problems as to whether the Institute has sufficient facilities to encourage more women students to enroll.

Along with that of other colleges and universities, the educational pattern of M.I.T. is changing to meet modern requirements. The Wesleyan study, already referred to, shows that the nation's ablest scholars tend to come from the high-cost, privately endowed institutions. The percentage of M.I.T. students who go into graduate work has been steadily increasing and now stands at about 25 per cent of the graduating class. Despite increased tuition, today's students pay only about 35 per cent of the cost of their Technology education, as compared to 45 per cent for the year 1939–1940. Another innovation of increasing importance is the growing number of scholars who come to the Institute for special or advanced study for a semester or so. Now no effective mechanism exists for affiliating them with the Association.

In a discussion of environmental factors, President Killian stated that the building program which the Institute has gone through during the past five years would meet earlier objectives with completion of the Kresge Auditorium and Chapel (to be dedicated on May 8) and the Compton Laboratories (to be begun this spring). He stressed the enthusiasm with which students had surveyed the need, and made proposals, for a student union and alumni center, but indicated the necessity of completing present commitments before these new structures could be undertaken.

Under miscellaneous items, President Killian stated that thoughts are already being given to the centennial celebration of M.I.T. to occur in 1961. Dr. Killian expressed the hope that a history of the modern M.I.T. might soon be written, and that this would emphasize the influence that M.I.T. and technical training have had on the development of the nation. He also announced that George R. Harrison, Dean of the School of Science, has accepted an assignment to write a biography of Karl T. Compton, to be published by the McGraw-Hill Book Company.

(Continued on page 302)

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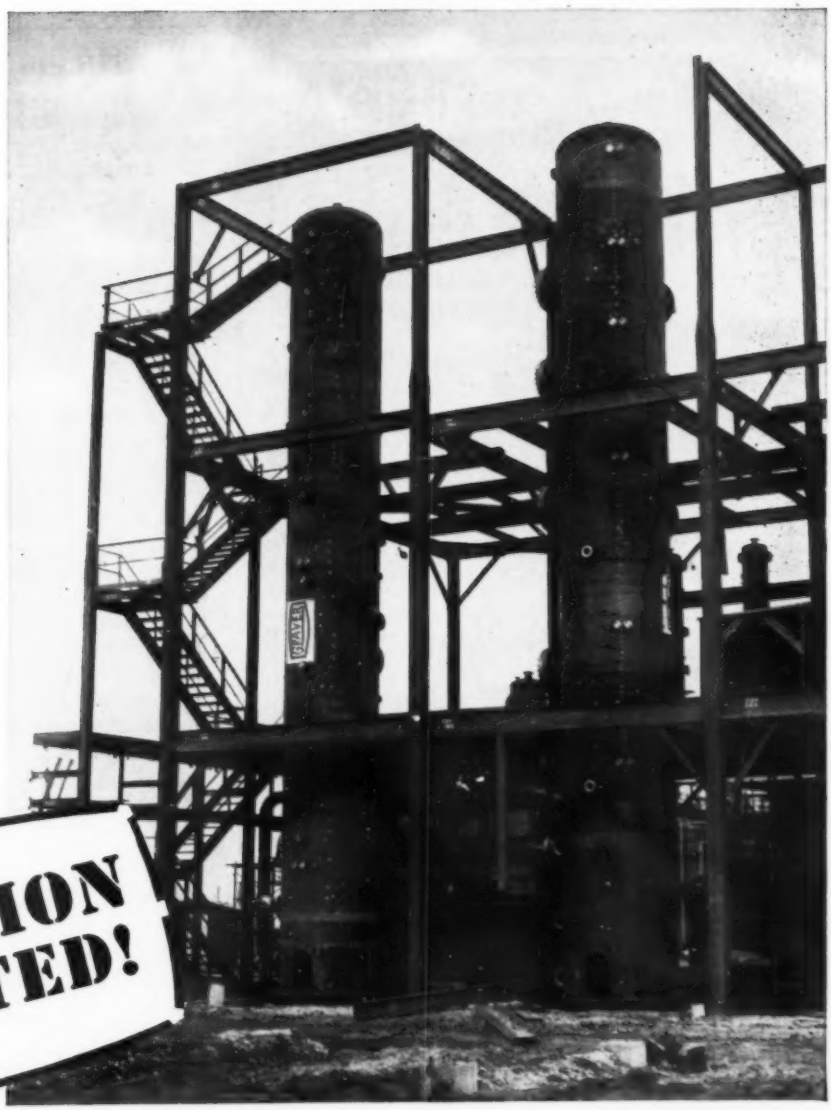

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THE INSTITUTE GAZETTE

(*Continued from page 300*)

Linguistically Speaking

THE role of modern languages in the curriculum of an institute of technology was carefully reviewed on June 8, 1954, by the Visiting Committee on the Department of Modern Languages* whose report was presented to the M.I.T. Corporation on June 11, and released for publication in The Review on September 29, 1954. A summation of the report is presented below.

The Department of Modern Languages must keep alert to opportunities to make new contributions to the educational picture of the Institute, in line with the new importance of foreign languages for Americans. That it is doing this is shown by the way it has taken advantage of two recent decisions of the Faculty to introduce timely subjects. Under the impetus of the report of the Committee on General Education of 1949, the Faculty voted enlarged scope of the humanities activities at the Institute, and more recently, it was decided to lighten the load of freshmen so that by offering a number of elective subjects, a greater variety might be introduced into the first-year program.

Beginning in the fall of 1953, the Department offered, to entering students having an unusually good background in French, opportunity to take humanities subjects in French, thus achieving a double benefit from putting their foreign language knowledge to work in the required humanities sequence. Charles W. Rosen, Assistant Professor of Modern Languages, was brought to M.I.T. especially to teach this course which has elicited favorable comments.

The other innovation in subjects offered by the Department of Modern Languages in 1953–1954 was the addition of two freshmen electives – one in

*Members of this Committee for 1953-1954 were: Rudolf F. Haffenreffer, '95, chairman (deceased), James M. Barker, '07, Antonio H. Rodriguez, '21, Jean M. Raymond, '34, John J. Desmond, Jr., Elton Hocking, W. Freeman Twaddell, and Father E. A. Walsh, S. J.

Members of this Committee for 1954–1955 are: John J. Desmond, Jr., chairman, B. Edwin Hutchinson, '09, Antonio H. Rodriguez, '21, Horatio L. Bond, '23, Jean M. Raymond, '34, Franklin S. Cooper, '36, Elton Hocking, and W. Freeman Twaddell.

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Spoken German and the other in Spoken French — to provide students with an opportunity to speak a language they had studied for several years in high school. The availability of elective time in the freshman year provided opportunity to offer such courses. Entering students with three or more years of German or French are now offered two semesters of spoken language training. Emphasis is on pronunciation and the patterns of conversation.

Spanish was dropped from the curriculum last year because falling enrollments made it seem uneconomical to continue to offer it for the present. A pronounced upturn in the other three languages is accounted for only by the addition of new language subjects and probably also by a new emphasis on oral work in elementary subjects.

Over the last few decades, language requirements have been gradually reduced at the Institute as well as elsewhere in the country, a tendency which the Committee feels is most unfortunate. In establishing requirements for admission to M.I.T., the Committee feels that greater consideration should be given to some preliminary training in foreign languages. Thus, further language study at the Institute would be complementary and on a more advanced cultural level than has been possible in the past.

The requirement that all doctoral candidates must show that they have a reading knowledge in two modern languages sufficient to read technical material in their field results in sizable enrollments in specialized language subjects. Graduate students in one semester achieve a minimum skill in getting the correct meaning from a scientific text. These subjects have become well known for teaching reading knowledge to graduate students more efficiently than any other method yet devised.

The Committee was favorably impressed with research being undertaken in the Department. Morris Halle, Assistant Professor of Modern Languages, has directed a project on speech analysis. Especially in the last year, considerable progress has been made and instruments have been developed which discriminate between certain classes of English sounds on the basis of physical measurements. Another active project is that of translating from one language to another by means of automatic equipment, using modern computers with large-scale storage. A new journal, entitled *Mechanical Translation*, has been initiated at M.I.T. by Professor William N. Locke, Head of the Department of Modern Languages,

(*Continued on page 304*)

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and Victor H. Yngve, research associate in the Research Laboratory of Electronics and assistant professor of Modern Languages.

The Committee feels that the Department of Modern Languages shows, by the vigor of its new programs in teaching and in research, that it is alert and forward-looking, and that the Department's program should receive continued encouragement.

Technology and the Humanities

THE Visiting Committee on the Department of Humanities* met in the Hayden Library Lounge at Cambridge and at the Algonquin Club in Boston on February 27, 1954. A report of the meeting was released for publication in The Review on September 29, and a condensation is presented in the following paragraphs.

All eight members of the Committee were present. Also in attendance, representing the Institute's Administration, were: James R. Killian, Jr., '26, President; John E. Burchard, '23, Dean of the School of Humanities and Social Studies; George R. Harrison, Dean of the School of Science; and Julius A. Stratton, '23, Provost. Professor Howard R. Bartlett, Head of the Department of Humanities, together with John M. Blum and Edward N. Hartley, Associate Professors of History, represented the Department throughout the day. A considerable number of senior department faculty members joined the group for luncheon at the Faculty Club, and the administrative officers and department representatives joined the Committee for dinner and evening discussion at the Algonquin Club.

The Committee took part with great interest in the discussions regarding the proposed Course XXI. Its members are unanimous in feeling that the development of this course is a natural and desirable evolution for M.I.T. The evidence is that M.I.T. graduates in very substantial numbers move out of the engineering and scientific fields and into the broader responsibilities of administrative work. This has been

* Members of this Committee for 1953–1954 were: James M. Barker, '07, chairman, Raymond C. Rundlett, '22, Andrew P. Kellogg, '24, Jacques Barzun, Alan W. Brown, John J. Desmond, Jr., Theodore P. Ferris, and Thomas C. Mendenhall.

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going on for many years. At present, however, it appears that the Institute may not be attracting enough top-grade candidates of the category who want a broad grounding in engineering or science, but whose major interest is in the direction of administration. Such men recognize the importance of a sound engineering or scientific foundation, but may feel that M.I.T. offers this with a greater degree of specialization than they feel is necessary for them. As a result, they may be lost to M.I.T. in favor of other institutions which offer what the candidate thinks of as a less specialized, and hence broader preparation for life.

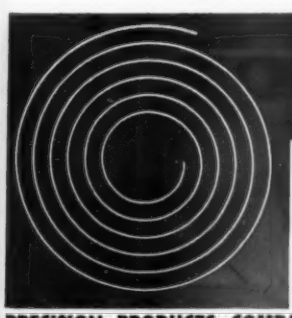
At the present time the Institute offers the curriculum of Course XIV, Economics and Engineering, to the candidates who wish to concentrate in economics. This is working successfully, and should continue to follow its present policy. The proposed Course XXI is designed to appeal to candidates who do not want to concentrate on engineering, science, or economics, but who recognize the importance of thorough grounding in these fields as preparation for careers involving broad social and industrial responsibilities.

The Committee wishes to make its recommendations specific in this matter of Course XXI by quoting with its approval the recommendations contained in a report on this subject to the M.I.T. Faculty Committee on Undergraduate Policy dated December 31, 1953. This report was made by an *ad hoc* committee with a membership drawn from the faculties of the School of Humanities and Social Studies, the School of Science, the School of Engineering, and from the Institute Administration, with Dean Burchard as chairman. These recommendations follow:

"I. (that) A four-year course of study be initiated at M.I.T. leading to a degree of S.B. without specification of science or engineering department. The curriculum of these four years shall consist of approximately 60 per cent basic science and engineering, 40 per cent humanities and social studies. Students concentrating in humanities would receive a degree in Course XXI; those concentrating in social sciences a degree in a modified and expanded Course XIV.

"II. (that) The curriculum in science or engineering be designed to permit a degree of S.B. with specification of a professional department on completion of a fifth year or a degree of M.S. on completion of a sixth year.

(*Concluded on page 306*)



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THE INSTITUTE GAZETTE

(*Concluded from page 304*)

"III. (that) To prevent indiscriminate sampling of subjects in humanities or social sciences, each student in the program be required to master a solid core of subjects comparable in both quantity and depth to that carried by a liberal arts major.

"IV. (that) The supervision of the new four-year S.B. degree be primarily the responsibility of the School of Humanities and Social Studies with departmental responsibility resting with the department in which the core of subjects is offered. Students undertaking the fifth year for a degree with specification should, of course, be under the jurisdiction of the appropriate department of science or engineering.

"V. (that) Faculty action at this time be permissive and that the exact date of initiating Course XXI be left to the discretion of the Administration."

CHANGING ROLE OF MANAGEMENT

(*Continued from page 290*)

it is an important one – but it is not its function to be solely responsible for dealing with people.

Let me summarize. I have talked about three significant threads in the fabric of our industrial life which seem to be emerging as a pattern. These threads are all elements of basic attitude and philosophy on the part of management. The first is the belief that the willing collaboration of people is the only sound way to achieve the objectives of a free enterprise system. The second is the growing confidence in the abilities and the potentialities of the ordinary man. The third is the emerging genuine self-confidence that includes a good measure of humility and a genuine social conscience.

These attitudes are not, of course, characteristic of all managements, nor of all individuals within any given management. The three points of view, as are summarized above, get built into a system only gradually, but I think they are beginning to have a profound importance in our free enterprise system. Over the next 15 or 20 years we will see unsuspected new developments resulting from these changes in management philosophy.

(*Concluded on page 308*)

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CHANGING ROLE OF MANAGEMENT

(*Concluded from page 306*)

For many years Clinton S. Golden – one of the great statesmen in the labor movement – has been saying that, by and large and in the long run, management gets the kind of labor relations it deserves. I think one can extend his statement and say that, by and large and in the long run, management also gets the kind of organizational effectiveness that it deserves.

I feel that management in this country is beginning to build a new, a healthier, and a more realistic relationship with the people who comprise our industrial organizations. As you can see, I am optimistic for the future.

GREAT FAMINES

(*Continued from page 292*)

been a frequent victim of starvation, notably in 1891, 1906, and 1911, although no reliable statistics are available as to the resulting mortality.

In view of the present bitter hostility of the Russian and Chinese communist regimes to everything American, it is interesting to note that our country has been most generous in the past in providing relief to these nations. When China was afflicted with famine in 1920–1921, the American Red Cross and the China Relief Fund spent 37,000,000 Chinese dollars in the feeding of 8,000,000 destitute persons. In the Russian famine of 1921–1923, about $70,000,000 was made available for relief, mostly from the United States – our government alone having appropriated $22,662,000 for this humanitarian purpose. With these funds, some 11,000,000 persons were fed. Gratitude is, of course, not one of the characteristics of the Communists.

Famine is by no means a thing of the past. Such disasters have occurred within the last generation; in the Ukraine in 1933, for example, and undoubtedly will occur again. In the Old World, if not in the New, the growth of populations always tends to outstrip available food supplies. The United States, Canada, Australia, and some of the South American nations are fortunate in having surpluses of foods, but in most other parts of the world there are deficits and shortages. Following the devastation of World War II, food production declined drastically in Europe and Asia, but it increased in North America, so that our donations of victuals to distressed areas saved millions of persons from threatened famine.

(*Concluded on page 310*)

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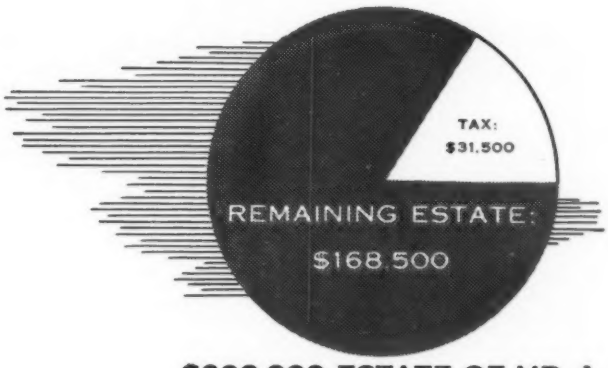
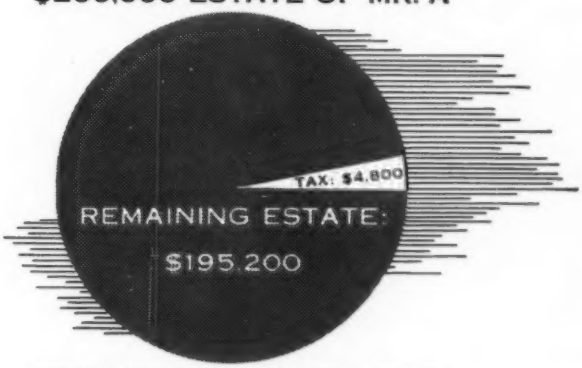


$200,000 ESTATE OF MR. A



$200,000 ESTATE OF MR. B

Mr. A's estate of $200,000 paid a Federal tax of $31,500.

Mr. B's estate of $200,000 paid only $4,800 in Federal taxes.

Mr. B cut the tax on his estate through planning. He took advantage of all the opportunities for cutting taxes that the law provides. Mr. A thought he was all set.

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GREAT FAMINES

(*Concluded from page 308*)

Governments and international agencies are becoming alert, however, to the situation. One of the most promising events in the endeavor to cope with future famines has been the establishment of the Food and Agriculture Organization of the United Nations. When set up in 1945, under the able direction of Lord John Boyd-Orr, this was the first organization of the United Nations, and it has since proved its worth. One of the first activities of this agency was to make an appraisal of the world's food position, which showed that conditions were much worse than most governments realized. More than that, however, F.A.O. has suggested ways and means by which improvements can be achieved. Although the forces of Nature often seem overpowering, it is not too much to hope that in the future the ingenuity and efficiency of man may overcome famine and hunger in most parts of the world.

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PEACEFUL USES OF ATOMIC ENERGY

(*Continued from page 286*)

doubtful. Looking ahead 50 years, I foresee that atomic power almost certainly will be a significant factor even in the United States.

Four years ago when I became a member of the General Advisory Committee, my attitude toward atomic power was about this: If it is not particularly needed in the United States at this time, why give it such a strong push? My attitude has changed quite completely. I now think it vital to support atomic power development with great urgency, not because the United States itself needs electricity from nuclear fission, today, but because sound public policy demands that we proceed vigorously to capitalize on the constructive potentialities of the atom.

There are many other evident uses of atomic energy, quite aside from its highly publicized application for producing electric power. Eventually its application in biology and medicine may well bring more benefits to man than even power will. In agriculture, all sorts of possibilities are being explored, such as the development of new and better strains by forced mutations and the studies of the movement of fertilizers into plants and through plants. A great deal of that which is new has been learned by studies with tagged atoms, and a good many preconceived ideas in fertilizer practice have been shown to be false and better methods are being developed. One little story I heard, about the elimination of a pest from a tropical island, will illustrate how broad our thinking must become when uses of atomic energy become commonplace. The female of a certain pestiferous fly leaves its larva in the skins of animals but this species has the unique characteristic that the female can mate only once during life. In the island set off as a test area, a large number of male flies were sterilized by irradiation. The net result was that the next generation never was born and the fly has disappeared from that test island.

Many of you have had experience with one or another industrial uses of atomic energy. Neutron logging and gamma ray logging of wells, and the setting of radioactive markers in wells, are examples. Techniques are becoming available for "seeing" things underground and behind walls. The use of radioactive tracers provides a highly useful understanding of many kinds of physical phenomena and makes possible an intelligent attack on problems where man's eyes are blind.

I might inject here a little comment about our own work at M.I.T. where a great deal of basic scientific work is being done on nuclear energy. About three or four years ago we started a graduate course in nuclear engineering under the direction of Manson Benedict, '32, Professor of Nuclear Engineering in the Department of Chemical Engineering.

(*Concluded on page 314*)

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PEACEFUL USES OF ATOMIC ENERGY

(Concluded from page 312)

Those of you engaged in oil refining or in the field of petro-chemicals may know him well. We are now designing a research reactor which we think will be the best reactor at any university in the country. It will have many values as a tool for education and research. In the first place, it will be put to use in the training of nuclear engineers. But, in addition, it will have many research potentialities in varied fields, such as solid state physics, metallurgy, biology, and food technology. The Institute is living up to its responsibilities and its opportunities in the new field of nuclear science and engineering.

In closing I would like to comment briefly on the President's atoms-for-peace program. The United States proposed that an international agency be set up to disseminate information and offer help, through all the world, in the peaceful development of the atom. You probably recall that the United States volunteered to give 100 kilograms of fissionable material through this agency. The British agreed to give 20 kilograms. In addition, the United States proposed that an international conference be held for the exchange of scientific and technical information on peaceful uses of atomic energy. The General Assembly of the United Nations unanimously adopted our proposal. The Russians have agreed to participate, and the Conference will be held next August in Geneva. I feel that this agency and this conference are bold moves to get us off dead center, to awaken a spirit of co-operation among nations, and to make the atom man's servant rather than his destroyer.

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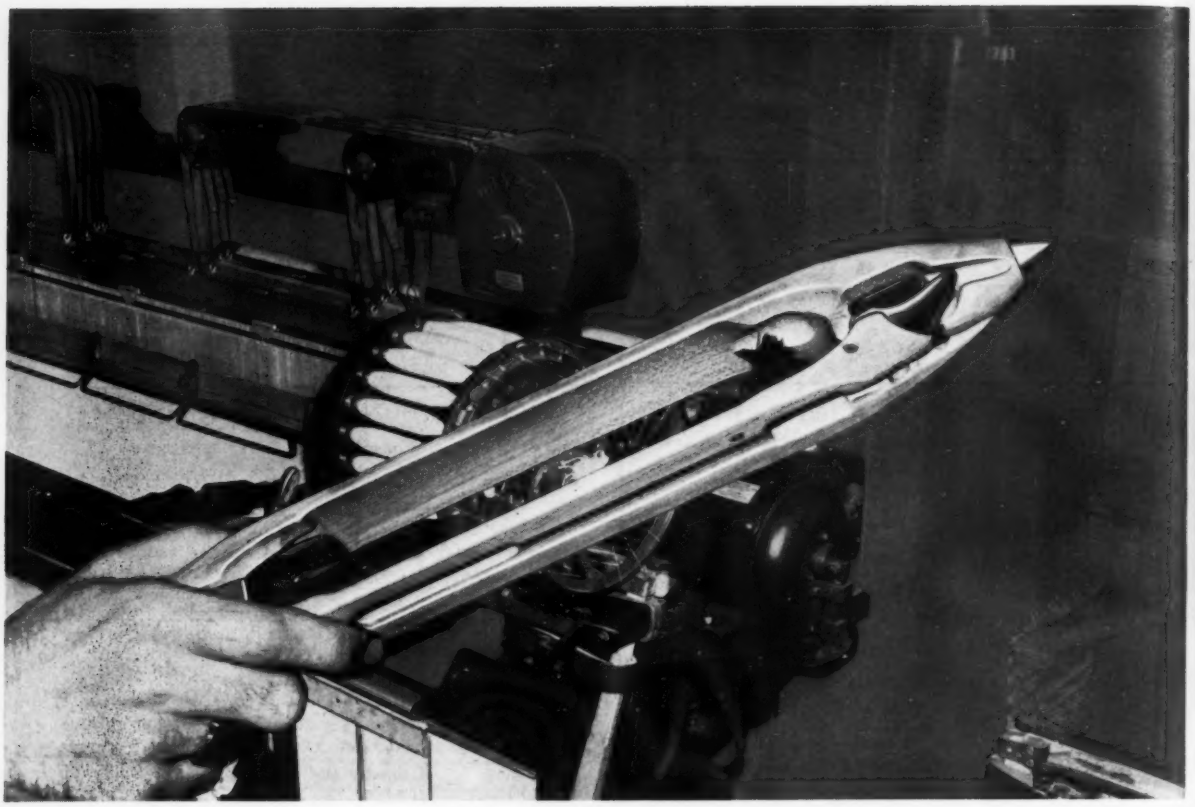

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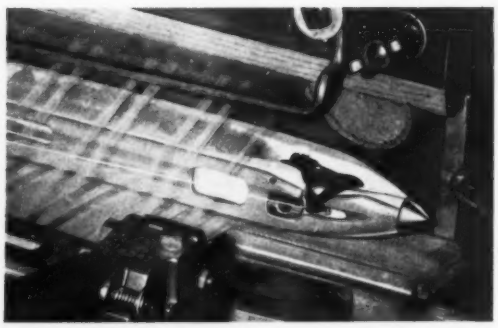

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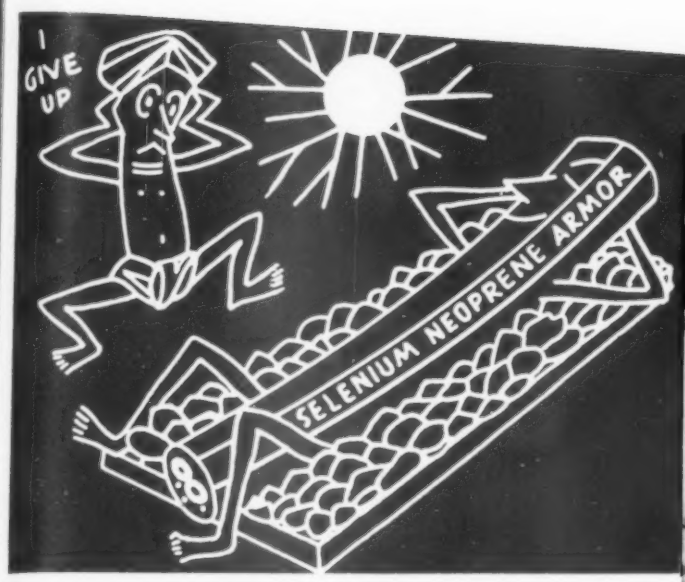

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